J. Nelson Spaeth

VOL. XXIII JANUARY, 1925 No. 1

JOURNAL of FORESTRY

Published by the

Society of American Foresters

Single Copies 65c **Yearly $4.00**

Entered as second-class matter at the post-office at St. Paul, Minn., under the Act of March 3, 1879. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized November 20, 1918

JOURNAL OF FORESTRY

A professional journal devoted to all branches of forestry

EDITED BY THE EDITORIAL BOARD OF
THE SOCIETY OF AMERICAN FORESTERS

The JOURNAL appears eight times a year—monthly with the exception of June, July, August and September.

The pages of the JOURNAL are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Raphael Zon, Lake States Forest Experiment Station, University Farm, St. Paul, Minn., or to any member of the Editorial Board.

Missing numbers will be replaced without charge, provided claim is made within thirty days after date of the following issue.

Subscriptions, advertising and other business matters may be addressed either to the JOURNAL OF FORESTRY, University Farm, Saint Paul, Minnesota, or to Atlantic Building, 930 F Street N. W., Washington, D. C.

J. Nelson Spaeth.

JOURNAL OF FORESTRY

Vol. XXIII JANUARY, 1925 No. 1

The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

RECENT PROGRESS AND TRENDS IN FORESTRY IN THE UNITED STATES*

By J. W. Toumey

I. INTRODUCTORY

When any nation wills to practice forestry, to the extent of making present expenditures for possible future gains, the conservation of forests becomes an established fact. The intensity of its practice ebbs and flows with every shift in public opinion and financial support. Thus, most nations at one period have neglected or even disposed of public forests, exposing them to unrestricted exploitation, and at other times have restricted exploitation and increased them through purchase. At one period the forest capital is increased only to be depleted at another. These ebbs and flows synchronize with changes in public opinion due to economic or other pressure.

A public opinion favorable to forestry practice rests on a fancied or real need for forests in National defense or for present or future economic use. In the early 19th century, when individualism ran riot in central Europe, the sale of all public forests was seriously considered in Germany. Due, however, to the foresight, influence and forest intelligence of Cotta, Hartig and a small group of influential citizens, public opinion shifted and saved Germany from possible forest destruction.

Following the Napoleonic wars, French forestry was badly neglected, and the forest capital greatly reduced. The development of an excellent system of forest laws early in the 19th century, supported by public opinion, was the basis for the progressive development of French forests down to the outbreak of the recent war.

Great Britain gave but little attention to forest conservation prior to the 20th century, but the recent war brought about a public recogni-

*Delivered before the meeting of the British Association at Toronto.

tion of the importance of forests in National defense. The public recognition of this need found expression in large expenditures for forest extension.

The rapid reduction in the accessible supplies of forest products in the northern hemisphere during the past half century, and the constantly upward trend in prices of all classes of forest products, is bringing a change in public opinion toward the necessity for forestry practice. Today every important nation is moving forward in the practice of forestry. The rate of progress, however, varies greatly in different nations because the practice of forestry involves present expenditures. Without expenditures forestry is academic, the practice is impossible.

II. THE FORESTRY SITUATION IN THE UNITED STATES

The United States, still having considerable bodies of virgin timber, has found it difficult to arouse a public consciousness that wills the practice of forestry. The habits of thought that came with years of extravagant use and abundant supply changed slowly. A rich forest capital has been depleted and values have advanced until today the price of certain classes of wood products actually exceeds the cost overseas. It is only in recent years that owners of forest property, both public and private, have been willing to invest money in obtaining reproduction and in organizing forests for sustained yield.

When we look back over the past twenty-five years we witness what appears like a remarkable advance in forestry practice in the United States. When we compare this advance, however, with the magnitude of the problem of supplying America with her certain future requirements for forest products, it is evident that scarcely more than a beginning has been made. This may be appreciated by comparing the present annual consumption of wood with the annual growth. The U. S. Forest Service places the annual withdrawal from American forests at more than 25 billion cubic feet of wood, or between four and five times the annual growth. We are still depending chiefly on the old timber in our rapidly diminishing virgin stands for the greater part of our consumption. We are just beginning to organize our cut-over and burned areas for successive crops and to cut existing stands in a manner to attain regrowth.

Approximately 850 million acres of virgin forest were within the present boundaries of the United States when settlement began more than three centuries ago. During the long period of land settlement

and agricultural expansion, forests had nowhere been organized for continuous yield. Early forest exploitation was largely confined to land suitable for agriculture, but gradually extended to nonagricultural land as well, and since 1850 our rapidly increasing requirements for home consumption and export have come in increasing amounts from absolute forest land. The habit of destroying the forests to make way for agriculture passed over into destroying the forests on nonagricultural land as well; land unsuited for agriculture and of no economic value except for the continuous production of forest crops.

In 1800 our annual wood consumption was relatively small and made but little imprint on our vast areas of virgin forest. In 1900 the United States led the world in timber consumption and export. Today we are taking from our forests more than one-half of the sawmill products consumed by all nations combined.

III. CAN AMERICA MAINTAIN HER FOREST SUPREMACY?

Can America continue to withdraw more than 25 billion cubic feet of wood annually from her rapidly vanishing forests without dangerously reducing her forest capital? It appears that she can not, were every acre of forest in the United States as well organized and as intensively managed as are the forests of central Europe. Without nation-wide forestry practice, without its extension beyond anything hitherto practiced on private as well as public forest land, our future requirements for wood can not be obtained from our own forests.

IV. THE TASK OF AMERICAN FORESTRY

The great task of American forestry is to build up a forest capital and develop a growing stock on all forest land that will provide, at least in a large measure, for the economic needs of the future. This means doubling, tripling, even quadrupling the annual growth before the remainder of our virgin stands are depleted. The rapidity with which this task is completed rests with public opinion fortified by financial support.

V. THE TREND OF PUBLIC OPINION FAVORABLE TO FORESTRY PRACTICE IN THE UNITED STATES

Public opinion favorable to forestry practice is shaped by men, events and economics. The importance of conspicuous leaders favorable to forestry practice cannot be overestimated. The leadership of Roosevelt and Pinchot in shaping public opinion in national forestry

and Rothrock in state forestry has been particularly conspicuous. Under the leadership of these men and others and with the assistance of various forestry organizations a formerly hostile or indifferent press has gradually become a champion of forestry practice. This is notably true of such publications as the New York Times, the Public Ledger and the Boston Transcript. There is need at present for more such influential leaders to maintain and strengthen public opinion. This need, however, is being supplied in a measure by our educational institutions and forest research stations.

In the short space of twenty-five years more than twenty educational institutions in the United States have offered courses in forestry. Most of these still continue their work in forestry and are progressively strengthening and extending their courses. In the space of fifteen years eight well equipped and efficient research stations have been organized in the United States Forest Service, with research in silviculture as a large part of their program.

Research has rapidly developed within the last ten years in a number of educational institutions, such as Harvard and Yale, that operate demonstration and research forests. The recent remarkable advance in the facilities for education in forestry and the equally remarkable advance in research indicates the trend of public opinion favorable to forestry practice, because both forestry education and forest research rest on public support.

Public opinion favorable to forestry practice made great progress during the war and since, due to a fuller realization of the need of domestic supplies of wood in large amount for national defense.

The remarkable industrial development of the United States in recent years, with the accompanying increase in wood requirements has brought about a progressive change in the cost of wood to the consumer. The upward trend in consumption has been matched by the upward trend in prices. So long as wood was relatively inexpensive the consumer thought little of the source of supply, but as cost increased he began to think of the source of supply and the possibility of its meeting the future requirements of his industry.

The users of wood in the United States are today more than heretofore looking ahead for supplies for the future requirements of their industries. This is evident in the present activities in the pulp industry and in the practice of forestry that this industry is now undertaking. It is also evident in the conservative lumbering coming into practice

by the Great Southern Lumber Company, the Kirby Lumber Company, the New England Box Company and many other companies and individuals in eastern, western and southern United States.

I have purposely dwelt at some length on the factors shaping public opinion favorable to forestry practice in the United States, because in a republic forestry is impossible without the support of public opinion combined with financial support.

VI. PROGRESS AND TRENDS

Progress and Trends in National Forestry: The greatest and most far-reaching forestry measure as yet accepted by the American people become a law in 1891 when the National Congress gave authority for the segregation of National forests from the unoccupied public domain. Under this law a net area of approximately 135 million acres is now detached from the public domain in the form of national forests. This does not include approximately 21 million acres of National forests in Alaska and approximately 2 4-5 million acres acquired or in the process of being acquired by purchase under the Weeks Law. This large acreage of National forests is now organized for sustained yield or is in the process of organization.

Unless public opinion favorable to forestry practice meets with reaction the United States can look forward to a progressive expansion in national forests, both by purchase and by further segregation from the public domain. This expansion, however, cannot meet our needs for forests organized for continuous yield. It cannot meet more than a part of our certain future requirements for forest products. The United States cannot depend on national forests alone for its future timber supply.

Progress and Trends in State Forestry: It is only within the past two decades that state forestry has made material progress in the United States. The present area of state forests and parks and of other state forest land is a little more than 8½ million acres. New York possesses 1½ million acres of state forest and Pennsylvania well over one million. The present trend is a progressive increase in state forests through purchase and gift. It is believed that the use of land within the state is largely a responsibility of the state, and that state forests paid for and controlled by the people of the state are closer to them than federal forests controlled from outside the state. Most state departments of forestry, as at present organized, serve four im-

portant functions, namely, the control and management of the state forests, the organization and operation of the state forest fire service, assistance to private owners in the organization and management of private forests and propaganda for better forestry. In many states as in Massachusetts, New York, Pennsylvania and Connecticut, the state department of forestry is strengthened through cooperation with and assistance by a strong state forestry association, of large local membership. These organizations are not only centers of propaganda for better forestry, but are important forces in securing effective state legislation and in raising funds for state and communal forests.

Progress and Trends in Communal Forestry: Although communal forests in the United States were established as early as the beginning of the 19th century, notably the one at Brunswick, Maine, the ownership of forests by counties and municipalities has appealed to the public only within the past ten years. The movement for such forests now under way in many parts of the country indicates that communal forests will in time become an important factor in forest conservation in the United States. Nearly half a million acres, mostly in small holdings, is now owned as municipal and county forests and the area is rapidly increasing as illustrated by recent activities in Massachusetts. Since 1913 twenty-three towns and cities in this state have secured communal forests through purchase and gift. In 1923 eighty additional towns and cities voted to appoint committees to study and report on the possibility of securing communal forests. To date nearly 30% of the municipalities of Massachusetts have taken some action on the securing of communal forests. This activity on the part of the public to establish communal forests is apparent in such widely separated states as Massachusetts, Illinois and California. The public is finding out that communal forests serve purposes that cannot be met as well by other classes of public forests. The sense of community ownership in nearby forests that serve for recreation as well as for direct utility purposes, is of far-reaching educational value and a great factor in creating public sentiment favorable to forestry practice.

Progress and Trends in Private Forestry: The policy of the American republic has been to further every measure that has had for its purpose the distribution of the unoccupied public domain in small holdings under private ownership. To a large measure this has applied to absolute forest land as well as to grazing and agricultural lands. As a result of this policy approximately four-fifths of the forests of the

country is privately owned. These privately owned forests are in small holdings attached to farms and known as woodlots or in larger holdings, often many thousand acres in extent in nonagricultural regions. Although national, state and communal forests, organized for sustained yield will be very important factors in providing for our future timber supply, the futility of depending on public forests for all or even the larger part of our future requirements is daily becoming more apparent. The greater part of our supplies must continue to come as they now do from privately owned timber land. If they do, radical and far-reaching changes from existing methods of operating private forests must take place. The practice of forestry by private owners must become nation wide and silvicultural practice must go hand in hand with fire protection.

Powerful economic forces are now working toward making private forestry possible and profitable. When certain classes of wood products, notably pulp, can be imported from Europe at prices that seriously compete with our own products as they now do, the possibility of continuous yield from private forests becomes more inviting. At present prices pine can be grown in the New England States, and in the Lake States, at a fair profit, and the area over which this is possible is certain to increase with the progressively upward trend in timber prices. With the relatively low cost of absolute forest land in the United States and the progressive increases in wood prices, stands of well managed timber are certain to be grown by private owners on a rapidly increasing scale. I believe, literally thousands of plantations of pine and spruce will be made in New England by private owners within the next two decades. At present nurseries are unable to meet the demands for forest planting stock. I also believe that when young natural stands of desirable species, such as pine and spruce, are suffering from competition with forest weeds such as gray birch, poplar, and soft maple, cleanings will increase. Already the practice of making cleanings in pine stands in New England is rapidly increasing.

The two factors which tend to check this progress are the uncertainty of the fire hazard and our antiquated forest taxation laws. The establishment of new forests and the organization of existing forests for sustained yield by private owners concerns the public even more than the private owner, and the public is beginning to appreciate this basic fact and act accordingly. Hence cooperation of the state and national government through the state with the private owner has, within the year, become a part of our newer forest policy. Massachusetts,

Connecticut, New Hampshire and other states have laws relieving plantations of commercial species from excessive taxation for a period of years. As yet, however, forest taxation in many parts of the country and particularly in New England mitigates against private forestry practice and changes in existing tax methods are desirable.

The recently enacted McNary-Clark law was framed for the purpose of stimulating private forestry. How can the United States check further forest devastation on privately owned land, improve existing second growth on such land and reforest the many millions of acres of private land now completely devastated? Two solutions have been offered. One, coercion on the part of the public, with laws compelling private owners to practice forestry, to so manage their forest property that devastation will be eliminated and continuous yield attained. The other, cooperation between the public and the private owner whereby the production of timber crops will be attained by acceptable silvicultural practice.

Although it is generally accepted that sweeping changes must be made from present methods of handling private timber lands, the public is not in accord as to the measures and means by which these changes can be affected most economically and advantageously. Various bills before our legislative bodies during the past ten years have aimed at a higher degree of regulation and control of private forest lands, by the public. Others aim to attain the results desired by cooperation. It is certain that legislation in one or the other direction is essential if regrowth be attained on private forest land, adequate for the future needs of the country.

The present trend in public opinion in the United States appears to be away from coercive measures, toward cooperation as expressed in the McNary-Clark bill. This bill, which became a law this year, provides ways and means for the National government to cooperate with the states in assisting the private owners of forest land in applying protective and silvicultural measures in managing their forests. This National legislation must be supplemented by state legislation which has for its purpose the reducing of the fire hazard to an insurable risk and the placing of forest taxation on a basis which will encourage silvicultural practice. In short, the states must provide larger funds.

In the past emphasis has been placed on the National forests and the development of the Federal forest service, more recently on state

forests and the development of the state departments of forestry. Emphasis is now being placed on communal forests. In the future it will be placed on private forests and means for their development.

With four-fifths of the forests of America privately owned, and with our policy of land ownership in private holdings, the development of private forestry is the only solution for an adequate future timber supply from domestic forests. The realization of this fact is expressed in present tendencies by the nation and state in obtaining state wide fire protection and in assisting private owners in silvicultural practice. Also in present activities in modifying existing laws relating to forest taxation. Although as yet, little progress has been made in attaining acceptable management of private forests, a beginning has been made. With continued cooperation with the private owner on the part of the nation and state, the possible progress in private forestry in the United States is almost unlimited. The present trend is in this direction and it is here that great progress most likely will be made in coming years.

A FOREST POLICY FOR NEW YORK STATE

By Harold Cahill Belyea,

The New York State College of Forestry,

AND

T. S. Woolsey, Jr.,

Consulting Forester

Every forward looking state in the Union now has a forest policy which to a greater or less extent approaches the four-fold standard established by the experts of the federal forest service. This standard is one developed from a long experience and wide investigation and is believed by its sponsors to approximate *summum bonum* of governmental activity in forestry, whether state or federal. In simple terms this four-fold standard may be summarized as follows:

(1) The protection of existing stands, from fire and other destructive agencies, (2) the regulation of cutting so as to have continuous production, (3) the readjustment of taxation so as to encourage permanent timber production, and (4) the reforestation of denuded and idle forest land by natural and artificial means, so as not to waste land space. The economic fulfillment of these policies requires the cooperation of all classes of owners—the state, the private individual and corporations. Furthermore, every class of forest—woodlot, estate, commercial forest, state forest and park must contribute its quota of wood material and its required area of protection forest or park area must be modified where regular commercial cutting is to be practiced. The objective must be clearly understood by every citizen: *A forest in being* is one that is best suited to the local and state needs.

New York must solve its forest problem under two considerable handicaps: (1) Too much productive forest area is tied up in state and private parks where no cutting of any kind is allowed, (2) the demands on the commercial forests cannot be met from local stands, therefore the temptation is to overcut. *During the past twenty years New York has been confronted by these two extremes of undercutting and overcutting.* The idea that a pleasure forest (or Adirondack Park) can never be cut must be corrected by the execution of successful winter logging operations at a profit without leaving the frequented portions of the park an eyesore. No one in Europe objects to well regulated cuttings provided certain beauty spots are left intact for the tourist—and even in beauty spots it is customary to remove the dead and dying

trees. An unhealthy decayed tree is certainly not as beautiful as the long boled healthy tree fit for timber. The idea that the commercial forest must be *overcut* and the forest investment liquidated as rapidly as possible must be combated and perhaps legislated against. If the owner must be content with a lower return on his investment for the economic welfare of the state, then it is reasonable for the state to offer a just compensation even if the means of adjustments are difficult and perplexing. It would clarify matters if it were generally admitted at the start that permanent forest investments pay low rates of interest on the capital tied up in growing stock.

If a statesman could combine and arrange the different forces that are now pulling in different directions, New York would eventually have:

Kind of Forest	Typical Location	Main Purpose	Method of Treatment
Farm Woodlot.	On Farm.	To supply farm with cordwood, posts, and timber for use and sale.	Cut as required or as labor is available; selection and clear cutting.
Park or Pleasure Forest.	Amid lakes and hills of Adirondacks	Camping, motoring, walking, and climbing. The production of some timber.	No cutting of healthy green trees at scenic points. Selection cuttings elsewhere, no clear cutting.
Protection Forests.	Slopes of mountains.	Protect mountain slopes and supply timber.	No cutting or light selection cuttings where commercially practicable.
Commercial Forest.	Remote acres and back woods.	Supply cordwood, pulp and timber.	Cutting according to demands with selection cuttings at scenic points.

In carrying out these principles the silvical demands of the dominant species; the economic logging requirements, the requirements for regulating the stand and the perpetration of the scenic forest values must all be co-ordinated and adjusted. The constitution of the State of New York, wherein it provides that in "forest preserves . . . the timber thereon shall not be sold, removed or destroyed," must be sanely modified so as to permit wide use. The sanctity of private commercial forests surrounding points of scenic value must be curtailed in some equitable manner so as to prevent unsightly slash.

With these practical objectives clearly in mind how should the state forest policy be developed? The points to be touched in the development of such a forest policy are as follows:

A. Scope and Forest Ownership.
B. Extension of State Forests.
C. Survey and Timber Census.
D. Management of the Forested Area.
E. Reforestation.

F. Protection.
G. Taxation.
H. Roads and Trails.
I. Administration.

A. SCOPE AND FOREST OWNERSHIP

1. The forestry problem in New York is state wide and is not restricted to the Adirondack and Catskill preserves.

2. It is believed that the best results in permanent forest production can be obtained from extensive public or state ownership of forest lands. Forest production is an activity for the state. Exploitation is a private activity. The bond between the two is regulation. The fundamental reasons in this paragraph are economic and need not be gone into here.

3. The prime requisite in the ownership of any land is the production of all benefits possible from its fullest development and utilization. Benefits may be revenue, protection of mountain slopes, conservation of water supply, fish and game or recreational use. This idea should apply to all state lands and forests.

4. While public forests should be largely added to, private ownership should be encouraged provided the private forests are managed in harmony with the public welfare.

B. EXTENSION OF STATE FORESTS

1. It follows from A2 that the areas owned by the state should be greatly increased over their present acreage, by purchase, or expropriation.

2. While the consolidation of the Adirondack and Catskill preserves is desirable, nevertheless it is believed that four important forest regions have been totally disregarded in the land acquisition plans of the Conservation Commission.

3. It is believed that one or more state forests, each of at least 1,000,000 acres, should be acquired and placed under management in each of the following sections:

a. In the westerly projection of the Adirondack forest, situated north of Oneida Lake and west and south of the Black River Valley known as "Tug Hill." This represents an area of true forest lands (spruce forest) though much run down through private exploitation.

b. In the northern projection of the Appalachian system through the southern tier of counties into Central New York. (True consolidation would be hard to attain but is possible to a limited extent along the axis of the hill systems).

c. In the Alleghany Highlands in the extreme western part of the state. Here we have the best example of the Central Hardwoods region in New York State.

d. In the highlands which are formed by the southwesterly projection of the Green Mountains, along the Vermont-Massachusetts border, south of Lake Champlain and east of the Hudson Valley.

C. SURVEY AND TIMBER CENSUS

1. A timber survey, timber census, and land classification should be made at once with provision for modifications made necessary by future changes in local conditions.

2. As a result of this full information would be at hand enabling:

a. A distinction between Agricultural and Forest soils.

b. The setting aside of definite forest areas belonging to the State where no cutting at all or light selection fellings only would be allowed:

I. Areas embracing some features of special scenic value such as the March Range, Whiteface Mountain, etc. (No cutting.)

II. Areas in virgin condition to be set aside as a perpetual memorial of the primeval forests. (No cutting.)

III. Areas contingent on lakes, rivers and trails valuable chiefly for camp sites and the recreation features. (No cutting.)

IV. Protection forests on mountain tops and steep slopes, the cutting of which would imperil landscapes, erosion and snow slides. (Light selection cuttings where practicable.)

V. Game refuges. (Protected both against hunting and lumbering.)

VI. Special areas adjacent to and contingent to water surfaces used for or valuable as reservoirs or conveyors of portable water. (Light selection cuttings where practicable.)

3. Areas included in Section 2, I-IV would total in area from 200,000 to 700,000 acres.

4. In all cases whether in the aforementioned "reserved" classes or in the following "non-reserved" class, cutting might be restricted within 200 feet of state roads much used by automobile tourists, along railroads, or other ways of transportation and accessibility as aforementioned. The purpose of this is to preserve scenic effects. It is to be remembered, however, that in a great many cases scenic effects can be enhanced by judicious improvement cuttings. Well executed thinnings are of interest rather than an eyesore, and when available to observation, can do more to advertise and advance the aims and purposes of technical forestry than a shelf full of books on many dissertations.

5. All the remaining state lands in the existing preserves or in future preserves to be utilized fully and carefully under direct technical supervision of the Conservation Commission, so as to realize both the direct returns from the mature timber and indirect returns from game and recreation.

6. Protective forests as outlined under Sec. 2b, I, Sec. 2b, III, Sec. 2b, IV, and also under Sec. 2b, VI, may be declared on privately owned land, where it is believed their cutting, either at all or destructively, will prove inimical to the public welfare. Under such conditions the private owner:

a. May (at his option) have the land expropriated and absorbed into the state forest, or

b. May (at his option) place the areas so designated under the management of the Conservation Commission which will make him a moderate charge for its administration. This assumes that there will be enough cutting to yield a revenue. Private areas declared protection forests should be exempt from all taxation as long as they are so held.

7. That in order to assist rapid reforestation, this survey should also include in its scope the making of a forestation reconnaisance, the conclusions of which are to be applied as outlined under the Section E Reforestation.

8. The designation and selection of the protective areas on private and state land, and of the various restricted areas on state land itself should be vested in the Conservation Commission.

D. MANAGEMENT OF THE FORESTED AREA

1. Only public (state) forests shall be under the direct management of the Conservation Commission and subject to its regulation, except:

a. Private forests declared protective under Sec. C2b, I, III, IV, VI.

2. Management on state lands shall be in accordance with definite management plans prepared by technical foresters, which will meet the demands of the site and local situation. Such plans can well be prepared by the foresters of the Conservation Commission.

3. It must be recognized that the community as a whole has a definite interest in the management of its forested areas. Whether this is expressed in its desire for assurance of the continuation of the supply of raw material for its wood working and wood using industries and the perpetuation of the existence and prosperity of the communities established by them, or whether it is a far-sighted desire to utilize all of its

land areas to their highest economic advantage, or whether it is a combination of any two or all three of these is of minor consideration. The point of major importance is that the interest exists and that the community has every right to initiate legislative measures to protect and executive measures to enforce the maintenance of this interest on all forest lands within its borders.

4. To this end private forest areas must expect in the future such State or Governmental control as will maintain the objectives of community interest outlined above. Whether it be expressed in further proscriptions as heretofore, the top topping law and the oil burning locomotives law being cited as cases in point; or whether it be expressed in more drastic regulations and control is not herein a matter of debate.

5. It would seem that the greatest efficiency and mutual satisfaction might come both to the community and to the private owner in an endeavor to coordinate management on private lands with public management on State owned lands through the medium of privately prepared working plans developed by technical foresters to meet certain standard minimum silvicultural requirements established by the State Administration of forested lands and submitted to this administration body for its approval. On the whole such co-operative efforts would achieve better results than rigid mandatory regulations.

E. REFORESTATION

1. Any reforestation program can only be instituted with success when it knows what and where the problems of reforestation exist. To this end as previously outlined under "Survey and Timber Census," the surveys of land classification and timber appraisal should include a planting reconnaissance, especially directed at classifying absolutely unproductive timber land.

2. With this data in hand an active planting program should be immediately instituted on all state lands which have not been or are not being reforested with success by natural means five years after denudation.

3. To encourage planting on private lands the nursery work of the State should be further enlarged and planting stock should be distributed at cost.

4. Private lands burned over and not restocked after five years (and the planting plan of the whole State each year should include private as well as state lands) should be planted under one of the following plans:

a. Planted by the private owner, with free planting stock at cost, owned by the state, and under loan advanced by State or Federal government, or both, acting cooperatively, the same to stand as a first mortgage on the property collectable with a low rate of interest at harvest.

b. Planted by the State, the labor charges (i. e., cost of planting) to be paid by the private owner either directly or under a similar scheme to the foregoing a. Under a. and b. all management subsequent to the planting is in the hands of the private owner.

F. PROTECTION

1. Protection from fire and other dangers is fundamental to any forestry program.

2. The fire protection system should be a state-wide interlocking system. It should combine the state look-out system with patrol and local town fire warden systems.

3. In the counties and towns chiefly agricultural the look-out system can function efficiently if coordinated with the local offices of the local town and county wardens. In the counties and towns chiefly forest the look-out system in addition must be backed up by:

a. Speeder patrol of railways.

b. Motorcycle patrol of state roads used mainly by tourists and campers.

c. Canoe patrol of rivers and lakes used by tourists and campers.

4. The expenses of the fire protection system should be borne by

a. The private owner (a small proportion) since the matter of protection and preservation of his timber is one of personal and financial interest. The amount which the private owner should contribute should be in direct proportion to (1) the amount or gross area of his timberland and the value of the stumpage thereon, and (2) to the degree of hazard which his operations entail. This hazard is a direct result from the amount, kind and condition of the slash left on the ground after logging. A premium should be set on clean logging by increasing the fir tax on slash land. During the first five years this tax should be heavy, and should become less as the natural decay of the slash progresses. At about 15 years after the logging operation, when the slash should be decayed, the tax should have been reduced to a minimum. This detail could be handled by the State Forest Administration on the same principles as Fire Underwriters act in cities and towns. By recognizing the responsibility of lumbermen in the fire situation and by bringing it home to him in classifying his operations according to the risk, we would be making a distinct step forward in forestry, and the

encouragement of private forestry. Just as soon as the lumberman sees and realizes that his former methods are placed at a premium, the sooner will he recognize the desirability of clean logging and the status of a Class A risk.

b. Town and counties should contribute to the forest fire protection system according to their proportionate area of forest land, since the perpetuation of forests means also the perpetuation of forest-using industries and local prosperity. The Administration Board should decide the amount to be contributed by each town or county.

c. The State should bear the major portion of the cost of protection since the major part of the protection system is under its jurisdiction.

5. The fund under which the state-wide forest protection is managed should be centered in and at the disposal of the Conservation Commission. The sources of this fund could be as follows:

a. Contributions from private owners in proportion to the area and the risk as classified by the Administration Board.

b. Contributions from towns and counties pro-rated on their forest area basis. While agricultural counties will bear the least, farmers' woodlots within their boundaries are to be subjects of protection and consideration.

c. State funds appropriated by the legislature.

d. Funds advanced by the Federal government in cooperation to meet the state contributions.

e. Portions of the revenues of the state forests inasmuch as these revenues should be available to support the forest as derived from:

(a) Timber sales.
(b) Hunting and game licenses.
(c) Recreation uses and camp-site leases.
(d) All other resources.

G. TAXATION

1. Forestry can only be placed on continuous production basis when the taxation problem on forest land is grappled with and solved. The following is suggested as a basis for its solution.

a. Land and timber to be taxed separately.

b. Land values to be taxed as at present.

c. Timber to be taxed at the age of maturity and defined by the working plan for the area or according to the accepted age of maturity for that particular species. The Conservation Commission should be the arbiter.

d. State timber lands should be subject to the tax for purpose of carrying out point "f."

e. Reserved or restricted land as previously outlined under protection forests, etc., whether private or state should not be subject to either land or timber tax.

f. In order to assist local towns and counties over the period between reproduction and harvest the State should act as banker during the deferred period in the collection of taxes. This sum, of course, will accrue to the State at the time of cutting from the yield tax.

H. ROADS AND TRAILS

1. In order to increase the accessibility of the State Forests for recreation purposes and for fire protection, 5% of the gross revenues of the State, from timber sales, hunting licenses and recreation uses, should be devoted to the extention, construction and maintenance of a system of forest roads and trails.

I. ADMINISTRATION

1. It is believed the actual administration of State Forests can best be carried out by the Conservation Commission.

2. It is believed, also, that the application of the State Forest Law to both State and private lands can best be carried out by the Conservation Commission. Its officers should supply the field force for the work.

3. It is believed by the writers that the administration of the forest law in respect both to its judicial and executive aspects should still be centered in the Conservation Commission but under the jurisdiction of a Forest Administration Board working through the Commission. The purpose of this Board is to seek an effective release of the Commission from all political control on the one hand and a centralization of its responsibilities on the other. Not the least of the reasons for the existence of this body is the responsible backing that it would give to the work of the Conservation Commission itself. The members of this Board should serve with no other emolument than their expenses, and as to the exact personnel of this Forest Administrative Board, it is at present not of great moment so long as it is absolutely of non-political character and fully representative of all the forest interests throughout the state.

4. The duties of this Board should be judicial in character:

a. To designate all protection and restricted areas under Ca 1, VIII, etc.

b. To designate protection or restricted areas on private land under Ea, VII, etc.

c. To coordinate the state planting program on private lands with that on public lands.

d. To act as a board of underwriters in assessing the amount to be contributed to the fire protection fund by private owners in proportion to the area of his land, the degree of protection, and the degree of the risk.

e. To assess towns and counties for the fire protection fund.

f. To consider and suggest to the legislature through the Conservation Commission, additions or amendments to the state law in order to increase its efficiency.

g. To be the arbiter in settling the questions arising out of the yield tax and other taxation laws.

h. To consider working plans made for private holdings and grant certain exemptions under them to state regulation or supervision in proportion to their benefit to the public weal and their coordination to the forest policy of the state as a whole.

i. To act as a court of appeal in the administration of the forest law.

A STUDY OF THE GROWTH OF SPRUCE AND BALSAM PULPWOOD ON CUT-OVER RIDGE LAND IN LEWIS COUNTY, N. Y.

By Edward Richards

The properties from which the field data for this study were secured were two tracts, one comprising 22,127.14 acres in the eighth Township, Towns of Montague and Osceola, and the ninth Township, Town of Highmarket, Lewis County, N. Y., and the other comprising 8,190.59 acres in the seventh Township, Town of Redfield, Lewis County. Both of these tracts are in what is known as the Osceola Wilderness and on the plateau between the Black River and Lake Ontario known as Tug Hill.

The elevations varied from 1,680 to 1,980 feet above sea level. The forest land was of two main types, swamp and upland (or ridge). In as much as most of the swamps were uncut, this study was confined to the upland. In general the forest was composed of gently sloping hardwood ridges or upland, interspersed with swamps, extending in general in a northerly and southerly direction. All of the area had been cut over for softwoods, sawlogs or pulpwood, and in places the hardwoods had also been cut. The upland, on which the growth study was made, was separated into two site classes, Quality 1 and Quality 2. The hardwood forest, beech, birch and hard maple predominating, made up most of the stand on Quality 1, there being only a scattering of spruce and in a few places some hemlock. Quality 2, on the other hand, contained a forest in which yellow birch is the most common tree, with a considerable proportion of soft maple, spruce and balsam.

In this forest the growth of the hardwoods is poor. The spruce is excellent, but is being crowded out by the hardwoods. The land does not seem able to produce as good quality of hardwoods as it can spruce, but the hardwoods have been gradually crowding out the small spruce after the original stand of large spruce was removed.

The average stand per acre for the whole area came to: Pulpwood, 1.5 cords; hardwood sawlogs, 1,681 board feet.

The average sawlog estimate was the actual merchantable stand including all timber which the cruiser judged could be sawn profitably in a portable mill.

In securing data for the following diameter growth table, notches were cut at breast height and the width of the last (outside) 10, 20, and 30 rings were measured. In all 426 spruce and balsam trees of all

diameters from 1 inch up were so tallied under DBH, species, current annual growth for each of the three 10 year periods, site, tree class and type. From these data the rate of growth during the past 30 years was calculated and the rate of growth for the next 20 years was assumed to be at the same rate as that of the past 30 years. The results follow in Table 1.

TABLE 1.

Growth in Diameter Breast High for Spruce and Balsam on Cut-Over Ridge Land, Lewis County, N. Y.

	SPRUCE						BALSAM					
	Quality 1			Quality 2			Quality 1			Quality 2		
	Present d.b.h.	D.b.h. in 10 yrs.	D.b.h. in 20 yrs.	Present d.b.h.	D.b.h. in 10 yrs.	D.b.h. in 20 yrs.	Present d.b.h.	D.b.h. in 10 yrs.	D.b.h. in 20 yrs.	Present d.b.h.	D.b.h. in 10 yrs.	D.b.h. in 20 yrs.
	Inches	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
Dominant	7	9	11	8	10	11	9	11	14	5	6	8
	8	10	11	9	11	12				6	8	9
	9	10	12	10	11	13				7	9	11
	10	11	12	11	12	14				8	10	11
	11	12	13	12	13	15				9	11	13
	12	13	14	13	14	16				10	12	14
	13	14	16	14	16	17				11	13	16
	14	16	17	15	17	18				12	14	16
	15	16	18	16	18	19				13	15	17
	16	17	18	17	19	20				14	16	18
	17	19	20	18	20	21				15	17	19
	18	20	21	19	21	22				16		
	19	21	22							17		
	20	21	23							18	20	21
	21	22	23									
	22	23	24									
	23	24	26									
	24	27	30									
Intermediate	7	8	8	6	7	8				4	5	7
	8	9	9	7	8	9				5	7	9
	9	9	10	8	9	10				6	9	11
	10	11	11	9	10	11				7	10	12
	11	12	12	10	11	12				8	10	13
	12	13	14	11	12	13				9		
	13	14	15	12	13	13				10	12	14
	14	15	16							11	13	16
	15	15	16							12		
	16	17	18							13	15	17
	17	18	19									
Suppressed	1	2	3	1	2	2	6	8	10	2	3	4
	2	3	3	2	3	3				3	4	5
	3	3	4	3	4	4				4	5	6
	4	4	5	4	5	5				5	6	7
	5	5	6	5	6	7				6	7	8
	6	7	7	6	7	7				7		
	7	7	8	7	7	8				8	9	9
	8	8	9	8	8	9				9		
	9	9	10	9	9	10				10	11	11
	10	11	11	10	10	11						
	11	11	12									
	12	12	12									
	13	13	13									
	14	14	14									

In plotting curves of total height on DBH, the attempt was made to plot separate curves of this kind for each of the three tree classes, for each quality of site and species, but insufficient data made it necessary to plot general curves instead, making the maximum curve, average curve, and minimum curve in each case take the place of the special tree class curves.

From these curves the heights of both species were read off for each quality of site, tree class, and d.b.h. The results are shown in Table 2.

The volumes of the trees of each species, DBH, quality of site, and tree class were calculated, using:

1. The DBH readings for present, and 10 and 20 years ahead from Table 1 above.

2. Total heights were taken from the height curves obtained from Table 2 above.

3. Volume table, based on DBH and total height of the tree found on page 239 in Cary's "Manual for Northern Woodsmen," 1915 edition, was used, taking figures directly for spruce and reducing by 10 percent for balsam. The table was interpolated to trees 10 feet high and 6 inches DBH and to trees 95 feet high and 26 inches DBH.

The Stand Table. In order to secure the data for the stand table, all of the tally sheets of the cruise were gone over and on such plots as were selected as being on cut-over land and upland, the total number of trees of each DBH and species being recorded. This table was then curved to give more regularity and then the number of trees per acre for each DBH was worked out by dividing the total number of trees by the total number of acres of plots of that special DBH and quality of site and tree class.

The Tree Class Stand Table. This table was worked up by examining the fifth plots of the cruise and the number of dominant, intermediate, and suppressed trees recorded there was taken for each diameter, species, and quality of site. These figures were then worked up into percentages so as to enable one to see what percent of the trees of each diameter were dominant, what percent were intermediate, and what percent were suppressed. Then these percentages were applied to the stand table, and the number of trees per acre for each diameter were divided up proportionally so that one might see just what the stand per acre was for each diameter of dominant, suppressed, and intermediate trees The results are given in Table 3.

TABLE 2.

Total Heights of Spruce and Balsam on Cut-Over Ridge Land, Lewis County, N. Y.

SPRUCE								BALSAM							
Quality 1				Quality 2				Quality 1				Quality 2			
D.b.h Inches	Total Height in Feet Dom.	Inter.	Sup.	D.b.h. Inches	Total Height in Feet Dom.	Inter.	Sup.	D.b.h. Inches	Total Height in Feet Dom.	Inter.	Sup.	D.b.h. Inches	Total Height in Feet Dom.	Inter.	Sup.
6	....	....	16	6	....	32	17	6	....	....	20	6	49	31	12
7	50	37	20	7	....	37	23	7	....	....	....	7	53	36	17
8	53	41	24	8	52	42	29	8	....	....	29	8	57	42	23
9	58	45	28	9	55	45	34	9	60	....	....	9	60	47	30
10	62	50	32	10	57	49	40	10	....	....	40	10	63	52	38
11	66	54	37	11	60	52	43	11	71	....	....	11	66	57	44
12	70	59	41	12	62	54	....	12	....	....	....	12	68	61	....
13	75	63	45	13	63	56	....	13	....	....	....	13	70	66	....
14	79	68	51	14	65	....	....	14	86	....	....	14	72	70	....
15	82	72	....	15	66	....	....	....	....	....	....	15	73	73	....
16	84	76	....	16	67	....	....	....	....	....	....	16	76	76	....
17	86	80	....	17	67	....	....	....	....	....	....	17	77	77	....
19	87	....	....	18	68	....	....	....	....	....	....	18	79	....	....
19	89	....	....	19	68	....	....	....	....	....	....	19	80	....	....
20	90	....	....	....	....	....	....	....	....	....	....	20	80	....	....
21	90	....	....	....	....	....	....	....	....	....	....	21	81	....	....
22	90	....	....	....	....	....	....	....	....	....	....	....	....	....	....
23	90	....	....	....	....	....	....	....	....	....	....	....	....	....	....
24	90	....	....	....	....	....	....	....	....	....	....	....	....	....	....

TABLE 3.

Total and Tree Class Stand Tables, per acre, of Spruce and Balsam on Cut-Over Ridge Land, Lewis County, N. Y.

SPRUCE

	Quality 1							Quality 2							
	Tree class Percent			Total Stand	Tree class stand table				Tree class Percent			Total Stand	Tree class stand table		
					Per Acre								Per Acre		
D.b.h.	Dom.	Inter.	Sup.	Per Acre	Dom.	Inter.	Sup.	D.b.h.	Dom.	Inter.	Sup.	Per Acre	Dom.	Inter.	Sup.
1	0	1	99	5.00	0	.05	4.95	1	0	10	90	20.38	0	2.03	18.35
2	0	7	93	2.84	0	.20	2.64	2	0	24	76	8.62	0	2.07	6.55
3	0	11	89	1.94	0	.21	1.73	3	3	36	61	4.93	.16	1.77	3.00
4	0	27	73	1.42	0	.38	1.04	4	4	46	50	3.89	.16	1.79	1.94
5	0	44	56	1.28	0	.56	.72	5	5	53	42	3.17	.16	1.69	1.32
6	0	52	48	1.14	0	.58	.56	6	12	55	33	2.75	.33	1.51	.91
7	7	47	46	1.00	.07	.47	.46	7	23	51	26	2.35	.53	1.21	.61
8	15	43	42	.85	.13	.37	.35	8	45	35	20	1.96	.89	.68	.39
9	21	41	38	.71	.15	.30	.26	9	68	18	14	1.65	1.12	.30	.23
10	25	41	34	.57	.14	.23	.20	10	67	24	9	1.32	.89	.32	.11
11	30	37	33	.42	.13	.15	.14	11	69	24	7	1.00	.69	.24	.07
12	36	32	32	.28	.10	.08	.10	12	80	12	8	.69	.55	.08	.06
13	45	30	25	.15	.07	.04	.04	13	100	....	....	.46	.46	....	....
14	50	28	22	.12	.054	.033	.033	14	100	....	....	.30	.30	....	....
15	80	20	....	.08	.06	.02	....	15	100	....	....	.17	.17	....	....
16	84	14	....	.07	.06	.01	....	16	100	....	....	.13	.13	....	....
17	75	25	....	.04	.03	.01	....	17	100	....	....	.10	.10	....	....
18	100	....	....	.02	....	....	....	18	100	....	....	.06	.06	....	....
19	100	....	....	.01	....	....	....	19	100	....	....	.05	.05	....	....
20	100	....	....	.01	....	....	....	20	100	....	....	.04	.04	....	....
21	100	....	....	.01	....	....	....	21	100	....	....	....	....	....	....
22	100	....	....	.01	....	....	....	22	100	....	....	.02	.02	....	....
23	100	....	....	.01	....	....	....	....	....	....	....	....	....	....	....
24	100	....	....	.01	....	....	....	....	....	....	....	....	....	....	....

TABLE 3—Continued.

Total and Tree Class Stand Tables, per acre, of Spruce and Balsam on Cut-Over Ridge Land, Lewis County, N. Y.

BALSAM

Quality 1								Quality 2							
	Tree class Percent			Total Stand	Tree class stand table				Tree class Percent			Total Stand	Tree class stand table		
					Per Acre								Per Acre		
D.b.h.	Dom.	Inter.	Sup.	Per Acre	Dom.	Inter.	Sup.	D.b.h.	Dom.	Inter.	Sup.	Per Acre	Dom.	Inter.	Sup.
1	0	5	95	.86	0	.04	.82	1	1	30	69	16.21	.17	4.86	11.18
2	0	6	94	.49	0	.03	.46	2	2	36	62	10.02	.20	3.61	6.21
3	0	7	93	.36	0	.03	.35	3	5	39	56	6.34	.32	2.47	3.55
4	0	10	90	.31	0	.03	.28	4	9	39	52	4.61	.41	1.80	2.40
5	0	14	86	.25	0	.04	.21	5	13	40	47	3.47	.45	1.39	1.63
6	0	34	66	.20	0	.07	.13	6	21	40	39	2.69	.56	1.08	1.05
7	0	40	60	.16	0	.06	.10	7	34	39	27	2.18	.74	.85	.59
8	8	37	55	.13	.01	.04	.07	8	47	33	20	1.74	.82	.57	.35
9	35	10	55	.09	.03	.01	.05	9	60	23	17	1.36	.82	.31	.23
10	63	5	32	.08	.05	.004	.026	10	91	6	3	.96	.87	.06	.03
11	85	3	12	.07	.06	.002	.008	11	83	17	...	.63	.52	.11	...
12	100	...	...	.05	.05	...	...	12	100	...	...	.38	.38	...	...
13	100	...	...	.03	.03	...	...	13	80	...	...	.25	.20	.05	...
14	100	...	...	.01	.01	...	...	14	100	...	...	.12	.12	...	...
...	...	...	...	...	...	...	...	15	100	...	...	.08	.08	...	...
...	...	...	...	...	...	...	...	16	100	...	...	.04	.04	...	...
...	...	...	...	...	...	...	...	17	100	...	...	...	...	...	...
...	...	...	...	...	...	...	...	18	100	...	...	.02	.02	...	...

TABLE 4.

Rate of Growth in Volume, per tree and per acre, of Spruce and Balsam on Cut-Over Ridge Land, Lewis County, N. Y.

SPRUCE

	Quality 1							Quality 2						
	Present D.b.h.	Vol. of Tree in Cords			Vol. per Acre, Cords			Present D.b.h.	Vol. of Tree in Cords			Vol. per Acre, Cords		
		Present	In 10 yrs.	In 20 yrs	Present	In 10 yrs.	In 20 yrs.		Present	In 10 yrs.	In 20 yrs.	Present	In 10 yrs.	In 20 yrs
Dominant Trees	7	.07	.14	.22	.0049	.0098	.0154	8	.09	.16	.20	.0801	.1424	.1780
	8	.10	.17	.22	.0130	.0221	.0286	9	.13	.20	.24	.1456	.2240	.2688
	9	.14	.17	.28	.0210	.0255	.0420	10	.16	.20	.30	.1424	.1780	.2670
	10	.17	.22	.28	.0238	.0308	.0392	11	.20	.24	.34	.1380	.1656	.2346
	11	.22	.28	.34	.0322	.0364	.0442	12	.24	.30	.38	.1320	.1650	.2090
	12	.28	.34	.42	.0280	.0340	.0420	13	.30	.34	.42	.1380	.1564	.1932
	13	.34	.42	.56	.0238	.0294	.0392	14	.34	.42	.46	.1020	.1260	.1380
	14	.42	.56	.64	.0227	.0302	.0346	15	.38	.46	.55	.0646	.0782	.0935
	15	.47	.56	.69	.0282	.0336	.0414	16	.42	.55	.60	.0546	.0715	.0780
	16	.56	.64	.69	.0336	.0384	0414	17	.46	.60	.66	.0460	.0600	.0660
	17	.64	.80	.87	.0192	.0240	0261	18	.55	.66	.71	.0330	.0396	.0426
	18	.74	.87	1.04	.0148	.0174	0208	19	.60	.71	.77	.0300	.0355	.0385
	19	.80	1.04	1.30	.0080	.0104	0130							
	20	.87	1.04	1.62	.0087	.0104	0162	....	....	....	....	1.1063	1.4422	1.8072
	21	1.04	1.30	1.62	.0104	.0130	0162	....	....	....	....	....	....	....
	22	1.30	1.62	1.96	.0130	.0162	0196	....	....	....	....	....	....	....
	23	1.62	1.96	1.72	.0162	.0196	0272	....	....	....	....	....	....	....
	24	1.96	....	....	.0196	....	....	....	....	....	....	....	....	....
	....	....	....	....	.3411	.4012	.5071	....	....	....	....	....	....	....
Intermediate Trees	7	.05	.07	.07	.0235	.0329	.0329	6	.03	.05	.07	.0453	.0755	.1057
	8	.07	.10	.10	.0259	.0370	.0370	7	.05	.07	.10	.0605	.0847	.1210
	9	.10	.10	.14	.0300	.0300	.0420	8	.07	.10	.14	.0476	.0680	.0952
	10	.14	.19	.24	.0322	.0437	.0552	9	.10	.14	.17	.0300	.0420	.0510
	11	.19	.24	.24	.0285	.0360	.0360	10	.14	.17	.22	.0448	.0544	.0704
	12	.24	.30	.36	.0192	.0240	.0288	11	.17	.22	.25	.0408	.0528	.0600
	13	.30	.36	.40	.0120	.0144	.0160	12	.22	.25	.25	.0176	.0200	.0200
	14	.36	.40	.48	.0119	.0132	.0158	....	....	....	....	.2866	.3974	.5233
	15	.40	.40	.48	.0080	.0080	.0096	....	....	....	....	....	....	....
	16	.48	.59	.69	.0048	.0059	.0069	....	....	....	....	....	....	....
	17	.59	.69	.75	.0052	.0069	.0075	....	....	....	....	....	....	....
	....	....	....	....	.2019	.2520	.2877	....	....	....	....	....	....	....
Suppressed Trees	5	....	....	.02	....	....	.0072	5	....	.02	.04	....	.0132	.0132
	6	.02	.03	.03	.0112	.0168	.0084	6	.02	.04	.04	.0182	.0364	.0182
	7	.03	.03	.04	.0138	.0138	.0092	7	.04	.04	.05	.0244	.0244	.0152
	8	.04	.07	.07	.0140	.0245	.0123	8	.05	.05	.08	.0195	.0195	.0156
	9	.07	.07	.09	.0182	.0182	.0117	9	.08	.08	.11	.0184	.0184	.0127
	10	.09	.12	.12	.0180	.0240	.0240	10	.11	.11	.15	.0121	.0121	.0165
	11	.12	.13	.16	.0168	.0168	.0224	....	....	....	....	.0926	.1240	.0914
	12	.16	.16	.16	.0160	.0160	.0160	....	....	....	....	....	....	....
	13	.21	.21	.21	.0084	.0084	.0084	....	....	....	....	....	....	....
	14	.26	.26	.26	.0086	.0086	.0086	....	....	....	....	....	....	....
	....	....	....	....	.1250	.1471	.1282	....	....	....	....	....	....	....

NOTE.—In calculating the number of trees per acre of each DBH and tree class it was assumed that:
1. All trees now standing would live for 10 years and remain in the same tree class as at present.
2. One half of the suppressed trees below 10 inches in d.b.h. now would be dead in 20 years.

NOTE.—It will be evident that at present balsam is increasing its percent of the forest. But although this is likely to continue through the 20 year period, it is thereafter, probably, due to change and a decrease in the amount of balsam will probably become apparent, provided the forest is let alone, owing to the short life of the balsam as pared with the spruce.

TABLE 4—Continued

Rate of Growth in Volume, per tree and per acre, of Spruce and Balsam on Cut-Over Ridge Land, Lewis County, N. Y.

BALSAM

Quality 1

	Present D.b.h.	Vol. of Tree in Cords: Present	Vol. of Tree in Cords: In 10 yrs.	Vol. of Tree in Cords: In 20 yrs.	Vol. per Acre, Cords: Present	Vol. per Acre, Cords: In 10 yrs.	Vol. per Acre, Cords: In 20 yrs.
Dominant Trees	9	.14	.24	.45	.0042	.0072	.0135
Intermediate Trees							
Suppressed Trees	6	.02	.05	.11	.0026	.0065	.0072

Quality 2

	Present D.b.h.	Vol. of Tree in Cords: Present	Vol. of Tree in Cords: In 10 yrs.	Vol. of Tree in Cords: In 20 yrs.	Vol. per Acre, Cords: Present	Vol. per Acre, Cords: In 10 yrs.	Vol. per Acre, Cords: In 20 yrs.
Dominant Trees	5	....	.045	.09	....	.0203	.0405
	6	.045	.09	.126	.0252	.0504	.0706
	7	.072	.126	.198	.0533	.0932	.1465
	8	.09	.171	.198	.0738	.1402	.1624
	9	.126	.198	.288	.1033	.1624	.2362
	10	.171	.252	.324	.1488	.2192	.2819
	11	.198	.288	.432	.1030	.1498	.2246
	12	.252	.324	.432	.0958	.1231	.1642
	13	.288	.387	.486	.0576	.0774	.0972
	14	.324	.432	.576	.0389	.0518	.0691
	15	.387	.486	.630	.0310	.0389	.0504
	16	....	....	....	....	....	....
	17	....	....	....	....	....	....
	18	.576	.693	.810	.0115	.0139	.0162
					.7422	1.1406	1.5598
Intermediate Trees	4	....	....	.045	....	....	.0810
	5	....	.045	.09	....	.0626	.1251
	6	.027	.09	.171	.0291	.0972	.1847
	7	.045	.126	.216	.0383	.1071	.1836
	8	.063	.126	.270	.0359	.0718	.1539
	9	....	....	....	....	....	....
	10	.126	.216	.324	.0088	.0151	.0227
	11	.171	.270	.432	.0188	.0297	.0475
	12	....	....	....	....	....	....
	13	.270	.387	.486	.0135	.0194	.0243
					.1444	.4029	.8228
Suppressed Trees	4	....	....	.009	....	....	.0108
	5	....	.009	.027	....	.0147	.0220
	6	.009	.027	.036	.0095	.0284	.0189
	7	....	....	....	....	....	....
	8	.036	.063	.063	.0126	.0221	.0110
	9	....	....	....	....	....	....
	10	.099	.135	.135	.0030	.0041	.0020
					.0251	.0693	.0647

The combination of all of the foregoing tables and data for the purpose of determining the growth per acre for each species and tree class in ten and twenty years will be found in Table 4:

Taking the figures from Table 4 of cords per acre for each species, quality of site, and tree class and arranging them in proper order the total number of cords per acre for each species and quality of site is found, as shown in Table 5:

TABLE 5.

Total volume per acre in cords for each species, by quality of site and tree class, at present, and in 10 and 20 years. (NOTE—These figures are from the growth study only and are to be applied to the actual cruising figures later to get the actual stands.)

	SPRUCE						BALSAM					
	Qual. 1			Qual. 2.			Qual. 1			Qual. 2		
	Total volume per acre in cords.						Total volume per acre in cords.					
	Present	In 10 years	In 20 years	Present	In 10 years	In 20 years	Present	In 10 years	In 20 years	Present	In 10 years	In 20 years
Dom.	.34	.40	.51	1.11	1.44	1.81	.004	.007	.014	.74	1.14	1.56
Int.	.20	.25	.29	.29	.40	.52	....	......	......	.14	.40	.82
Sup.	.12	.15	.13	.09	.12	.09	.003	.007	.006	.03	.07	.06
	.66	.80	.93	1.49	1.96	2.42	.007	.013	.021	.91	1.61	2.44
Percent of increase...		21	41	....	31	62	86	200	......	77	168	......

In the above table the percent of increase shows the increase only, the actual stand at present having to be added in each case to get the stand in each case. For instance, in spruce quality 2 the stand in 20 years increases 62 percent over the stand at present. But the actual stand in 20 years would be *the present stand,* plus 62 percent.

We are now ready to apply the figures found in the study of the growth of the forest to the actual figures of the contents of the forest found in the cruise. (NOTE.—It should be noted that the study of the volumes found from the growth study figures were only to be used to find *the rate at which the forest was growing.* The actual contents ot the stand as determined by the much larger number of measurements of the cruising work will be used to find the actual contents of the forests in 10 and 20 years, because of the greater accuracy obtained by using the larger number of measurements.)

The stand found by the cruiser was: Spruce, 17,008 cords; balsam, 7,151 cords.

The total area of the forest considered in the growth study was 15,261 acres of which: Quality 1 covered 7,859.4 acres; Quality 2 covered 7,401.6 acres; total, 15,261 acres.

From Table 5 the present stand of spruce per acre was: Quality 1, .66 cords; Quality 2, 1.49 cords. 7,859.4 acres times .66 cords per acre equals 5,187 cords, or 32 percent; 7,401.6 acres times 1.49 cords per acre equals 11,028 cords, or 68 percent.

Now applying these percentages to the cruising figures: 32 percent of 17,008 equals 5,443 cords, being the total stand of spruce on Quality 1 at the present time. 68 percent of 17,008 equals 11,565 cords, being the total stand of spruce on Quality 2 at the present time.

From these figures the contents of the two qualities of site in 10 and 20 years may be found for spruce by multiplying by the respective percentage of increase as given in Table 5.

Similar procedure will yield similar results in the case of balsam.

Summarizing the results outlined above the following final table completes the whole study:

TABLE 6.

Stand of Spruce and Balsam on Quality 1 and Quality 2 in 10 and 20 years as compared with the present.

Spruce	Area in Acres	Presen Stand in Cords	Stand in 10 yrs. Cords	Percent Increase	Stand in 20 yrs. Cords	Percent Increase
Q. 1.	7,859.4	5,443.	6,586.	21	7,675.	41
Q. 2.	7,401.6	11,565	15,150	31	18,735	62
	15,261	17,008	21,736		26,410	
Balsam Q.1.	7,859.4	57.	106	86	171	200
Q.2.	7,401.6	7,094.	12,556	77	19,012	168
	15,261	7,151	12,662		19,183	

IN DEFENSE OF BRUSH[1]

By Hugh G. Calkins,

Supervisor, Coronado National Forest

To one of Mr. Leopold's major conclusions—that over-grazing, far more than fire, must be held responsible for erosion in southern Arizona—I can heartily subscribe. I cannot, however, agree that grazing wields its destructive influence through the formation of brush thickets. To the contrary, on the basis of a localized study, supported by data admittedly less accurate than those which lend authority to Mr. Leopold's assertions, an attempt will be made to show that brush neither causes abnormal erosion, nor originates primarily from grazing.

Let it be understood that the following remarks apply to the Coronado Forest region, some 6,000 square miles of southern Arizona, with about 1,500,000 acres of National forest land ranging in elevation from 2,500 to 9,800 feet. The term "brush" applies to the denser cover of mountain slopes as distinguished from lower foothills and desert, where mesquite, catclaw and the various cacti predominate. Scrub forms of manzanita, ceanothus, are, as components of the Coronado brush type, less frequent than even-aged aborescent thickets of various evergreen oaks, of which *Quercus hpyoleuca* is perhaps the most abundant. Evidence that, within the last few decades, the density of certain brush areas has increased is as strong as that cited by Mr. Leopold, but some of his other statements of fact seem open to question.

"Widespread abnormal erosion," as applied to brush, has not been observed. On the contrary, as clearly evidenced by the ease of providing drainage for trails in the brush type, erosion is much more severe in the grass-covered foothills, even where grazing is moderate. Flood damage and erosion in a Chiricahua mountain stream, Cave Creek, in 1921, was plainly caused by rapid run-off from a normally grazed "thick-grass-thin-brush" area comprising not over one twenty-fifth of the entire watershed. The south fork of this creek, heavily brushed through and a semi-permanent stream, persistently refuses to be "riled" during periods of heavy precipitation.

That fire damage has been reduced along with white settlement and the stocking of the ranges with cattle is perhaps a tenable theory, but I doubt it. Considering that systematic fire protection has been intro-

[1]A reply to "Grass, Brush, Timber and Fire in Southern Arizona," by Aldo Leopold, Journal of Forestry, October, 1924.

duced within the past 20 years and that the early settler viewed with complacency the destruction of "worthless" brush and woodland, I would rather take my chances with the well-known reluctance of lightning fires to travel down hill from their usual origin in pine timber, and with the Indian, whose reputation for light-burning has never been definitely established.

Will the theory of brush kept thin by fire, grass destroyed by grazing, and the resultant "climax type"—brush—hold water? Certain definite observations lead to the belief that fires tend to increase brush-density by producing several sprouts where but one grew before and that the present brush areas were never heavily grazed because the ground is steep and rough and supports less palatable grasses than are found on lower slopes. It is rather hard to believe that abnormal grazing brought on the substitution of a climax—for a temporary—type; in fact it seems more reasonable to suppose that temporary types now exist, for example, where fire has caused yellow pine to recede upward, followed by brush in which coniferous reproduction is gradually taking hold again—or, as another instance, where, in the desert country, heavy grazing has resulted in a scarcity of grass and a wider dissemination of cacti and mesquite.

The inference that brush fields do not carry fire is also open to question. It is doubtless true that fires more often start in grass than in brush, but equally true that a fire striking a brush field on a mountain slope frequently travels with greater rapidity than if the same slope were covered with grass. A brush fire of recent occurrence in the San Bernardino mountains is reported to have travelled from an elevation of 1,000 feet to a crest at 5,000 feet in 35 minutes. Like action, less accurately timed, has several times been observed in the Coronado region.

Mr. Leopold's statements that reduction of the Arizona brush hazard by grazing is impracticable and that agricultural interests, in a region like the Roosevelt Reservoir drainage, over-balance range interests, are indisputable. Nevertheless, I doubt the validity of his argument that southern Arizona forests have been administered on a mistaken theory that "we must keep the brush hazard down to the extent necessary to prevent serious fires." If any generally accepted theory existed it was that grazing is necessary to keep down general fire hazard, without special reference to the grazing of brush. Present-day grazing administration is based on a more conservative application, rather than on a reversal, of the former policy.

Mr. Leopold says that "it was not until fires ceased and grazing began that abnormal erosion occurred." Speaking again for the Coronado Forest region, the weight of old settlers' evidence is that numerous fires burned uncontrolled during the pre-forest service days, and swept the mountains, even in the heyday of "big outfits," range competition, and over-stocking. The fact that one-third of one per cent of the Tonto now burns annually is not conclusive proof that a much greater percentage did not burn before the period of enlightened fire protection. Just as the cattle were concentrated on flats and foothill ranges in the early days, there was a concentration of fires on the brush-covered mountain slopes. Considering the prolific sprouting tendency of virtually all brush species except manzanita, it does not seem unreasonable to suppose that grass has been eliminated as much by brush-competition following fires as by grazing.

Below is quoted Mr. Leopold's summary of the present situation, with comments based on local experience.

1. "There has been great damage to watershed resources." This is true of the more open areas, accessible to stock, where grass predominates. Numerous instances could be cited of brush-covered watersheds where no abnormal erosion has occurred. Erosion varies inversely with the density of brush.

2. "There has been great benefit to the timber resources." In the region observed great benefit has occurred where fires have been kept out and reproduction of the more valuable species—juniper and the various pines—preserved.

3. "There has been great damage to range resources." Such damage as has occurred has been largely confined, not to brush fields, but to the lower ranges, where erosion damage has also been the most severe.

On the Coronado, an attempt is being made to extend cattle-grazing on a moderate scale to the higher, rougher slopes where grass occurs in mixture with browse species, not so much to reduce hazard as to secure better utilization of forage resources and relieve such concentration of stock as now exists on lower ranges. Goat-grazing, frequently advocated as an aid to reducing brush-hazard, seems largely a delusion and a snare because of the seeming impossibility of obtaining proper distribution and preventing soil damage by many sharp-footed animals confined to small areas.

There is a silvicultural sidelight to the brush question. If the demand for cordwood permitted, enormous improvement in the composition of stands could be secured through the selective thinning of oak

with a view to reducing root and crown competition and accelerating the growth of juniper and pine reproduction. It is believed that coppicing can be held to a minimum by the judicious application of this method. Unfortunately the market for cordwood is such that the solution of the problem on a large scale must be left to the foresters of the future.

While this article expresses disagreement with some of Mr. Leopold's conclusions it is a pleasure to acknowledge the value of such a definite record of observations as a valuable contribution to a subject which, as he clearly shows, deserves far more consideration than it has in the past received.

A STUDY IN COMPARATIVE LENGTHS OF TRACHEIDS OF RED SPRUCE GROWN UNDER FREE AND SUPPRESSED CONDITIONS

By W. B. MacMillan, M. F.*

Red spruce (*Picea rubens. Sarg.*) will readily and quickly recover when released from suppression. This fact was forcefully brought out in a recent study of spruce growth in which the writer participated. During that study many increment borings were made of trees of various ages. The extremely slow growth during years of suppression was shown by the very small annual rings. In some cases more than ten rings were found in less than one-tenth of an inch. Other trees grown free showed as few as three and four rings to an inch. The question arose as to the comparative length of tracheids in the two kinds of growth.

Samples of red spruce were secured from seven different places in eastern United States and Canada, within the range of the tree. Table I shows locations from which samples were secured.

TABLE I

Sample Numbers	Location	From Whom Received
1 and 2	North Carolina	C. F. Korstian, U. S. F. S.
3, 4, and 5	West Virginia	West Virginia Pulp & Paper Co.
6	New York (Adirondacks)	Finch Pruyn and Co.
7 and 8	Canada, (Lotbiniere, P. Q.)	Finch Pruyn and Co.
9 and 11	Maine	Orono Pulp & Paper Co.
10	New Hampshire (White Mts.)	Supervisor, U. S. F. S.

The original plan was to get samples of both free and suppressed growth from each location, but so much more suppressed growth was available and so little free growth that the majority of the samples showed a preponderance of suppressed growth. Hence nearly two-thirds of the measurements were made from suppressed growth.

To standardize the problem all samples were secured from trees at four and one-half feet from the ground, or breast height. The part to be measured was taken from the average radius of the sample. Every tenth annual ring was measured, except where the suppression was so extreme that it would be difficult to segregate rings so close together, in which case the twentieth or in a few cases the thirtieth rings were selected.

*Instructor in Forestry at the Pennsylvania State College.

TREATMENT OF SAMPLES

All samples were allowed to air dry at room temperature for several months. All the samples had practically the same amount of moisture in them when work was begun on them, so no differences of results could be due to that factor. From each sample a piece was taken along the average radius. Pieces were of such size that a good supply of wood in each ring could be secured. The rings in each piece were then counted and every tenth ring marked. Counts were made from the pith to the bark. The distance from pith was then measured and the difference between measurements showed the growth in 10 years. In many cases it was less than one-tenth of an inch.

The rings that were to be mascerated and counted were then cut out from the piece. This required careful whittling, but the demarkation of spring and summer wood was generally so plain that little difficulty was encountered. Every ring so separated was placed into a small bottle bearing a label which showed the sample and ring number. After all rings had been cut from a piece they were ready to be chipped and mascerated or "cooked." Chipping was done with a knife. The parts of the annual ring were cut into fine chips or split into very small sections similar to small pencil shavings. They were kept in the same labeled bottles throughout the operation. As soon as one ring was chipped the chips were covered with water and a few drops of concentrated nitric acid added. They were allowed to stand in this dilute acid for several hours or over night, as time permitted. The acid acted on the lignin to soften it, without hurting the cellulose content of the wood or the tracheids.

Masceration or "cooking" was the next step in the process. The chips were transferred from the bottles to a test tube and concentrated nitric (HNO_3) acid added till there was a majority of acid in the test tube. By holding the tube in a gas flame the acid was brought to a boil in a minute or two. Boiling hastened the action of the acid on the lignin. Best results were obtained when the boil was kept up for four or five minutes, then potassium chlorate ($KCLO_3$) was added. It had a bleaching and further loosening effect on the lignin, so that separation quickly took place. As much as could be held on the end of a knife blade was sufficient. It immediately caused an effervescence in the boiling acid. Caution had to be exercised to keep from losing the wood when the $KCLO_3$ was added, for it frequently caused boiling over. Care had to be taken, also, to keep the strong acid from burning the operator.

The amount of wood, the amount of acid, and the amount of potassium chlorate all varied in every case, so no hard and fast rule could be set for amounts of materials. Likewise the time for cooking varied. When the "fibres" appeared as a pulp and boiled quite easily in suspension it was then time to wash them and stop the action of the acid. Too much boiling destroyed the entire "cook". For washing, the pulpy mass was dumped into a pan of water. This diluted the acid so it would not react on the copper wire screen. The tracheids were then washed out onto the wire screen and the water drained off. Fresh water was run over them for several minutes to remove all the effects of the acid. They were then placed again into the labeled bottle from which they, as chips, had been removed. Water was placed over them to keep the mass from drying and by shaking the mass the loose fibres came nearer the surface and the heavier pieces not well mascerated sank to the bottom. They were then kept until measured. This period was never more than a few hours or over night.

METHOD OF MEASURING TRACHEIDS

A compound microscope was fitted up with an ocular micrometer scale. This scale was calibrated by use of a standard stage scale, and at various times during the work the scale was checked. Each division on the micrometer scale equalled .0266 of a millimeter. A movable stage on the microscope made it possible to move the slide bearing the tracheids without losing sight of the one under observation.

When ready to make the measurements a pipette was used to remove the tracheids from the bottles. This material was placed in water on a regulation slide. A cover glass was placed over it and the work of measuring then took place. The tracheids from the first few rings were usually short enough to come within the fifty divisions of the micrometer scale, but when longer ones were encountered it was necessary to move the stage or the slide to get the full length. To do this it was necessary to carefully note any points that could be used as the end of the first fifty divisions and the beginning of the next. No measurements were made of broken tracheids. No measurements were made of wood parenchyma cells, which were long and sharp pointed and had no bordered pits, as have tracheids. In picking out the tracheids to be measured only those were selected which were in good condition. Care was exercised not to measure the same ones twice. To do this a systematic survey of the slide was made, beginning at one corner, working down that side, shifting the field to right or left then up to the top, and

so on until the whole slide had been covered. If fifty measurements had not been made a new slide was prepared. This was repeated until a total of fifty measurements had been made from each bottle of material. In a few cases 100 measurements were made and divided by two for an average, but this did not give any appreciable difference in the number at each length.

SYSTEM OF RECORDS

As soon as a measurement had been made it was tallied. Sheets were prepared with a column for each annual ring. Each column was properly labeled to correspond to the labels on the bottles. A separate sheet was used for each sample. The tally was kept in the forest service style, by the dot and dash system. A check tally was kept at the top of each column for a total. When the check tally showed fifty no further measurements were made. The length tally was then totalled to see that it agreed with the total tally. In any cases where it did not, the extreme tallies were cancelled or more tallies were added in their proper place. As soon as all measurements on a sample had been completed and tallied the mascerated material was thrown out.

The next step was to get the tallies into a workable form. For this sheets of cross-section paper were prepared with ten divisions to the inch. From the record of the piece cut out of the sample the free and suppressed rings were known. A sheet was prepared for every ring counted, both free and suppressed. Every tally of a given ring of a given condition, i. e., free or suppressed, was plotted on the same sheet. For instance, if there were found in all samples five thirtieth annual rings free grown they would all be plotted on the same sheet. A different symbol was used in the plotting for each sample. In some cases but one ring would be tallied on a sheet, whereas others had as many as seven samples represented. In plotting the tallies the number of measurements was used for ordinates and the lengths of tracheids in micrometer scale divisions was used for abscissae.

After all tallies had been plotted the average for each division point was figured and an average curve drawn through those points. These curves never represented 100% of the measurements. In cases where but one ring had been plotted the curve represented about 50%. But usually the curves represented more than that. The general average was about 75% of all fibres represented on the plotted sheets. A key of the symbols was made on each sheet of plottings to insure a correct record throughout. Each sheet was properly headed, suppressed and

free, and the ring number shown. Thus sheet S7 was a tally of suppressed ring number 60. S1 was the 1st ring, S2 the 10th ring, S3 the 20th ring, etc.

From the average curves was read a table of the number of tracheid measurements in each ring at different lengths. See Table II. Reading from left to right in this table the total number of measurements was found for the given lengths. Summing up these totals gave a grand total of the number of average measurements at all lengths. Taking this total and dividing it into each total in the column gave the percentages of fibres at each length.

Table III was then prepared to show the percentages of tracheids of different lengths in each ring. The number of measurements in each ring were totaled and each number divided by that total to get the percentage. This showed the distribution within individual rings.

RESULTS AND CONCLUSIONS

From Tables II and III it is possible to get some idea of the results of the study. The final results were not clear until the total percentages of Table II were plotted. Curves were drawn showing the trend of the suppressed and free fibres. Both curves are normal. At first the suppressed fibres show a distinct advantage in length over the free grown. After the average point is reached, or about 2.926 mm. the lines of the curves cross and the free grown take the lead and maintain it to the end. By taking the difference between the total per cents as shown in Table II and making a summary of the differences, it was found that the lead gained in the shorter lengths is exactly balanced by the lead taken by the free grown in the longer lengths.

The differences are as follows:

Suppressed	Free
1.46	5.70
2.83	4.22
3.38	4.50
3.31	2.26
1.25	.62
2.46	.90
.99	
1.09	
1.43	
18.20	18.20

This is a rather striking fact. Although in the suppressed the differences are smaller there are more of them. In the free the differences are larger but fewer in number. The indication brought out by these figures is that there is no radical difference in the amount of fibres of each kind.

The suppressed trees show a higher percentage of short lengths of tracheids. Conversely the free grown trees show a higher percentage of longer tracheids. The two curves cross at the 112th division or at 2.0792 mm. Up to that point the curve of suppressed rings rises more rapidly and beyond that point it drops more rapidly. The spread between the two curves is approximately equal in both rise and decline, as is shown by the differences above. From this it is evident that the free grown trees have a higher percentage of longer tracheids and conversely the suppressed trees a higher percentage of shorter tracheids.

By comparing the minima and maxima measurements in Table II of free and suppressed rings of the same age it was found that in minima measurements 76.47% are shorter for suppressed than for free, 11.76% the same length, and 11.76% longer for suppressed than for free. Conversely for maxima measurements the free growth showed 70.59% longer, 11.76% same length, and 17.65% shorter than suppressed.

Tables II and III show that the trend of the tracheids is to elongate from the pith toward the bark. There is no direct evidence for the cause of this greater length, but it is known that the cambium cells increase in size as the tree increases in age. Another factor might be that with greater age and larger size there comes a greater pressure on the mature cells causing longer interlocking of the tracheids and thus causing greater length. This trend of increased length away from the pith bears out the findings of Shepard and Bailey, (1914) and of Lee and Smith, (1916).

From this study some answers may be suggested to the questions raised by Messrs. Shepard and Bailey. In regard to the question, "Is there a uniform rapid increase in tracheid length during a period which corresponds roughly to the period of most rapid height growth?" The curves would indicate that such an increase takes place. Although it could hardly be said that the increase in length was very rapid. No evidence is found to indicate an answer to the second question, "Is the first marked decrease in fibre length associated with the retardation of height growth?" Question three is similar to question one and the answer is

the same. "Does tracheid length increase gradually, with various fluctuations, until the tree reaches maturity?" The results of this work would indicate an affirmative answer.

To find the average tracheid length in the samples studied the frequency method was used. Averages were figured for each ring, both free and suppressed. The extremes were used to balance against each other until but one length remained and this was called the average. For suppressed the average was 95 divisions or 2.527 mm., and for free the average was 105 divisions or 2.793 mm., giving an average for all of 100 divisions or 2.660 mm. Charts were drawn showing diagramatically (1) the average tracheid lengths and (2) the range of lengths of tracheids found in the study, as read from the final curves: .80 to 4.52 mm.

2.52 mm............................Average suppressed
2.66 mm............................Average of all
2.79 mm............................Average free

No correlation could be determined between lengths of tracheids in samples from the northern and southern parts of the range of red spruce.

The question of the relation between grades of paper and the lengths of fibre composing that paper has been raised, but no material has been found on that subject.

No definite cause has been ascertained for the variation in lengths of the free and suppressed growth.

TABLE II.

Spruce: Suppressed.

Number of Total Measurements. Read from Average Curves. Annual Ring Numbers.

Millimeters	Div.	1	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	Total	Total in Per cents
.2660	10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	......
.5320	20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.....
.7980	30	12	8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	20	2.90
1.0640	40	10	6	9	5	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	32	4.63
1.3300	50	7	7	8	10	3	3	..	..	3	..	..	1	..	..	..	..	..	..	..	..	..	..	42	6.08
1.5960	60	2	6	4	7	7	6	4	..	5	..	..	3	..	..	..	..	..	..	..	..	..	..	44	6.37
1.8620	70	..	7	3	4	5	7	6	6	5	3	2	3	..	..	..	..	..	..	..	..	..	..	51	7.38
2.1280	80	..	9	6	4	4	5	7	7	7	6	4	3	2	7	3	..	2	2	..	..	..	..	78	11.29
2.3940	90	..	5	6	4	4	4	4	6	7	8	7	7	3	2	5	5	3	2	..	..	2	..	84	12.16
2.6600	100	..	..	5	6	7	4	6	2	4	4	4	6	5	7	2	13	1	13	..	..	5	2	96	13.89
2.9260	110	..	..	5	3	4	5	4	3	4	3	6	6	7	8	9	6	6	10	..	..	7	1	97	14.04
3.1920	120	..	..	4	2	2	5	2	2	3	5	4	3	2	1	7	1	5	4	..	..	4	3	59	8.54
3.4580	130	..	..	1	..	8	7	2	..	..	..	..	..	7	..	5	3	10	2	..	..	3	10	58	8.39
3.7240	140	..	..	..	..	7	3	..	..	..	..	..	..	4	..	..	..	..	4	..	..	5	3	20	2.89
3.9900	150	.	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..	5	8	1.16
4.2560	160	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	2	.28

Spruce: Free.

Number of Total Measurements. Read from Average Curves. Annual Ring Numbers.

Millimeters	Div.	1	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	Total	Total in Per cents
.2660	10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	....
.5320	20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	....
.7980	30	8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8	1.44
1.0640	40	6	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	10	1.80
1.3300	50	7	2	..	..	..	..	..	..	..	..	6	..	..	..	..	..	..	..	..	..	..	..	15	2.70
1.5960	60	6	4	3	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..	..	17	3.06
1.8620	70	6	5	2	5	..	1	..	..	2	..	4	..	9	..	..	..	..	..	..	..	..	..	34	6.13
2.1280	80	1	6	5	7	5	3	..	..	6	5	4	..	4	1	..	..	..	..	2	..	..	..	49	8.83
2.3940	90	..	6	9	5	3	2	3	3	6	3	3	..	4	5	8	..	..	..	2	..	..	..	62	11.17
2.6600	100	..	5	5	3	8	6	2	5	5	6	4	1	5	2	1	3	..	..	8	..	2	..	71	12.80
2.9260	110	..	2	3	4	6	4	6	3	4	5	5	3	6	6	3	5	..	..	2	..	3	..	70	12.61
3.1920	120	..	..	1	3	3	6	2	5	4	3	5	8	5	9	1	11	..	..	6	..	7	..	79	14.24
3.4580	130	..	..	5	..	..	4	6	5	7	4	5	7	4	2	7	7	..	..	3	..	4	..	70	12.61
3.7240	140	..	..	4	..	..	..	4	3	3	3	4	4	..	..	6	2	..	..	..	..	8	..	41	7.39
3.9900	150	..	..	..	..	..	..	..	5	2	1	..	3	..	..	..	3	..	..	..	..	5	..	19	3.42
4.2560	160	..	..	.	..	..	..	..	..	2	3	..	..	..	..	..	..	..	..	..	..	..	..	5	.90
4.5220	170	..	..	..	..	..	..	..	..	..	5	..	..	..	..	..	..	..	..	..	..	..	..	5	.90

TABLE III.

Spruce: Suppressed.

Percentages of Total Measurements. Read from Average Curves. Annual Ring Numbers.

Millimeters	Div.	1	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210
.2660	10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
.5320	20	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
.7980	30	38.71	16.67	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1.0640	40	32.26	12.50	17.65	11.11	....	....	....	....	....	....	....	5.89	....	....	....	....	....	....	....	....	....	....
1.3300	50	22.58	14.58	15.69	22.22	5.88	6.13	....	....	7.89	....	....	2.94	....	....	....	....	....	....	....	....	....	....
1.5960	60	6.45	12.50	7.84	15.56	13.73	12.24	11.43	....	13.16	....	....	8.82	....	....	....	....	....	....	....	....	....	....
1.8620	70	....	14.58	5.88	8.89	9.81	14.29	17.14	23.08	13.16	10.36	7.41	8.82	....	....	....	....	....	....	....	....	....	....
2.1280	80	....	18.75	11.77	8.89	7.84	10.20	20.00	26.92	18.42	20.71	14.82	8.82	5.73	28.00	9.68	....	7.43	5.41	....	....	....	....
2.3940	90	....	10.42	11.77	8.89	7.84	8.16	11.43	23.08	18.42	27.55	25.93	20.59	8.53	8.00	16.13	17.86	11.12	5.41	....	....	....	7.69
2.6600	100	....	....	9.81	13.33	13.73	8.16	17.14	7.69	10.53	13.77	14.82	17.65	14.30	28.00	6.45	46.43	3.72	35.10	....	....	19.23	8.33
2.9260	110	....	....	9.81	6.67	7.84	10.20	11.43	11.54	10.53	10.36	22.20	17.65	20.00	32.00	29.03	21.43	22.21	27.03	....	....	26.93	4.17
3.1920	120	....	....	7.84	4.44	3.92	10.20	5.72	7.69	7.89	17.25	14.82	8.82	5.73	4.00	22.58	3.57	18.51	10.82	....	....	15.38	12.50
3.4580	130	....	....	1.94	....	15.68	14.29	5.71	....	....	....	....	....	20.00	....	16.13	10.71	37.01	5.41	....	....	11.54	41.67
3.7240	140	....	....	....	....	13.73	6.13	....	....	....	....	....	....	11.45	....	....	....	....	10.82	....	....	19.23	12.50
3.9900	150	....	....	....	....	....	....	....	....	....	....	....	....	8.53	....	....	....	....	....	....	....	....	20.83
4.2560	160	....	....	....	....	....	....	....	....	....	....	....	....	5.73	....	....	....	....	....	....	....	....	....

Spruce: Free.

Percentages of Total Measurements. Read from Average Curves. Annual Ring Numbers.

Millimeters	Div.	1	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210
.2660	10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
.5320	20	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
.7980	30	23.53	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1.0640	40	17.64	11.77	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1.3300	50	20.60	5.89	....	....	....	....	....	....	....	....	13.65	....	....	....	....	....	....	....	....	....	....	....
1.5960	60	17.64	11.77	8.10	....	....	....	....	....	....	....	9.09	....	....	....	....	....	....	....	....	....	....	....
1.8620	70	17.64	14.70	5.41	18.52	....	3.85	....	....	4.88	....	9.09	....	24.33	....	....	....	....	....	....	....	....	....
2.1280	80	2.95	17.64	13.51	25.93	20.	11.54	....	....	14.63	13.16	9.09	....	10.81	4.00	....	....	....	....	8.69	....	....	....
2.3940	90	....	17.64	24.34	18.52	12.	7.69	13.04	10.35	14.63	7.89	6.82	....	10.81	20.00	30.76	....	....	....	8.69	....	....	....
2.6600	100	....	14.70	13.51	11.11	32.	23.08	8.70	17.24	12.19	15.79	9.09	3.85	13.51	8.00	3.85	9.68	....	....	34.79	....	6.90	....
2.9260	110	....	5.89	8.10	14.81	24.	15.38	26.09	10.35	9.76	13.16	11.36	11.54	16.22	24.00	11.54	16.13	....	....	8.69	....	10.35	....
3.1920	120	....	....	2.70	11.11	12.	23.08	8.70	17.24	9.76	7.89	11.36	30.76	13.51	36.00	3.85	35.48	....	....	26.09	....	24.14	....
3.4580	130	....	....	13.51	....	....	15.38	26.09	17.24	17.07	10.53	11.36	26.93	10.81	8.00	26.92	22.58	....	....	13.05	....	13.77	....
3.7240	140	....	....	10.82	....	....	....	17.38	10.34	7.32	7.89	9.09	15.38	....	....	23.08	6.45	....	....	....	....	27.59	....
3.9900	150	....	....	....	....	....	....	....	17.24	4.88	2.64	....	11.54	....	....	....	9.68	....	....	....	....	17.25	....
4.2560	160	....	....	....	....	....	....	....	....	4.88	7.89	....	....	....	....	....	....	....	....	....	....	....	....
4.5220	170	....	....	....	....	....	....	....	....	....	13.16	....	....	....	....	....	....	....	....	....	....	....	....

SOME RATIOS OF FORM IN ADIRONDACK SWAMP SPRUCE

By Harold Cahill Belyea

New York State College of Forestry

The following is submitted as a preliminary study of the form and taper of Swamp Spruce in the Western Adirondacks. Its completion will be a series of taper ration or form class volume tables on the Swedish model.[1]

Two principal objectives were sought in the present study. First and mainly to seek or approximate the average model or models on which the trees of this species are naturally constructed; to see if this model is varied to any great extent and how through the influence of the variables of breast height diameter, total height; and to note if these averages depart, and how radically, from the standard models established by European and other investigators. And, second, to determine the values of the standard ratios of form, namely form quotient and form factor as influenced by the same variables of breast diameter and height. The form quotient value determined was that of the absolute form quotient, namely the ratio between the DBH and the d½ when the latter is measured at a point exactly half way between the tip of the tree and the point of DBH measurement.

Excellent opportunity was offered for the collection of field data in the cuttings of the International Paper Company near Cranberry Lake, St. Lawrence County, New York. Measurement crews of two men each followed the loggers and endeavor was made to co-ordinate the measurements taken with type and site quality. This was done both to serve as a basis of comparison and elimination of the effect of any possible influences that these factors might exert.

This study represents part of the work within the Spruce Swamp Type. It was arbitrarily chosen for presentation here due mainly to a feeling of greatest confidence in the standardization of the type classification and the uniformity of the site quality designation. Whether the latter is to be classified as Site IV or Site something else is not of great moment, the main thing is its uniformity. Site quality designation within the standard Adirondack types is as yet an untrodden field in forest investigation.

The method in which the field measurements were taken was, briefly, as follows: All felled trees were measured for DBH (both

[1]See references 1, 2 and 5.

inside and outside of bark) and for total height. In the felled tree particular care was taken to get the DBH measurement at its true position on the butt log. The distance between absolute DBH and the top of the tree was then measured and was divided into ten equal sections and D I B measurements were made at each point of section. The values for each tree were kept on separate sheets. Subsequently the actual form class value (i. e. absolute form quotient) was entered upon each sheet for future reference and classification.

As before stated the bulk of the work of this present study was directed toward the securing within each diameter and height class average indices of form as expressed through the media of the ratios of absolute form quotient or form class and of form factor. The former data is first presented in Tables I and II, the two tables differing from one another in the method of presentation rather than the

TABLE I

Table of Taper Percents of Swamp Spruce
Township No. 2, McCombs Great Tract No. 2, St. Lawrence Co., N. Y.
Taper Percents
(Based on 751 Trees)

Diameter Measurements Expressed as Percents of DBH														
				At Points on Tree Bole above DBH expressed as % of distance between DBH Point and Total Height										
DBH Class	Total Height Class	DBH Inches	Total Ht. in Feet	0	10	20	30	40	**50**	60	70	80	90	100
4	30	4.1	30.7	100.0	95.5	93.0	88.1	83.1	**78.2**	68.3	61.0	41.6	24.9	0.0
	40	4.3	40.4	100.0	95.6	91.0	86.2	81.4	**76.9**	69.6	55.9	42.0	20.2	0.0
	50	4.4	40.0	100.0	95.5	91.2	88.7	86.6	**74.7**	68.3	50.0	31.9	18.9	0.0
5	30	5.0	33.3	100.0	96.2	92.3	85.9	82.2	**76.3**	68.1	60.0	46.2	22.1	0.0
	40	5.1	38.0	100.0	96.1	90.4	86.3	80.5	**72.5**	66.8	56.9	43.3	23.7	0.0
	50	5.2	47.4	100.0	92.5	86.7	80.7	78.9	**71.3**	65.4	53.8	36.2	21.5	0.0
6	30	6.9	32.4	100.0	94.7	90.6	84.7	79.3	**74.6**	61.8	50.0	36.7	23.3	0.0
	40	5.9	41.1	100.0	95.1	90.0	86.7	81.4	**73.0**	67.8	55.9	40.7	22.1	0.0
	50	5.9	48.2	100.0	95.4	93.5	90.1	79.6	**71.2**	64.5	54.3	40.7	22.1	0.0
7	30	6.9	31.9	100.0	94.4	90.0	88.6	79.9	**74.2**	71.1	62.3	39.2	21.9	0.0
	40	6.9	41.6	100.0	93.	90.0	84.2	78.3	**72.6**	63.7	52.2	37.6	20.3	0.0
	50	7.1	49.9	100.0	93.0	86.2	83.4	77.6	**71.5**	61.9	49.4	35.1	19.5	0.0
	60	6.9	59.3	100.0	96.9	88.7	81.3	73.9	**65.3**	55.1	44.9	36.2	18.9	0.0
8	40	8.1	40.7	100.0	93.8	88.7	83.7	78.9	**73.7**	62.0	51.9	36.7	24.1	0.0
	50	8.1	50.5	100.0	95.4	91.4	84.2	78.1	**71.4**	61.7	51.9	38.3	22.3	0.0
	60	8.1	59.4	100.0	96.2	92.7	85.4	80.5	**70.4**	62.9	53.2	33.4	18.3	0.0
9	40	8.9	42.4	100.0	93.5	86.7	79.9	76.9	**73.0**	63.9	42.7	31.5	19.9	0.0
	50	9.0	51.7	100.0	93.5	88.0	83.5	77.9	**71.2**	62.2	50.0	36.6	21.1	0.0
	60	8.9	58.6	100.0	94.3	89.9	85.4	77.4	**70.9**	60.7	50.6	33.7	18.0	0.0
10	40	10.0	41.0	100.0	90.1	86.0	79.0	76.0	**73.0**	64.0	45.0	31.0	21.0	0.0
	50	10.0	50.6	100.0	89.0	83.0	80.0	75.0	**71.0**	58.4	48.0	34.0	21.0	0.0
	60	10.2	57.5	100.0	94.2	87.3	83.5	75.5	**69.0**	59.7	50.1	36.3	19.6	0.0
	70	10.0	66.0	100.0	91.0	84.0	79.0	74.0	**67.0**	58.0	46.0	28.0	15.0	0.0

Note—The heavy line relatively indicates the approximate position of the base of the crown.

material contained. In each of these tables in order to determine the influence of the entry of the bole into the crown upon the degree of taper, the approximate position of the crown has been indicated. It is to be noted that the larger sized trees show a larger relative proportion of the bole occupied by the crown. This is important.

A further development of the height class differentiation is that it in reality is a tree class differentiation in which the 60-70 foot trees may be classed as Dominants, the 50 foot trees as Co-Dominants, the 40 foot trees as Intermediates and the 30 foot trees as Sub-Dominants or Suppressed. Table II is offered mainly to bring out the relationships or lack of relationships to be noted under the heading of tree class.

TABLE II

Table of Taper Percents of Swamp Spruce
Township No. 2, McCombs Great Tract No. 2, St. Lawrence Co., N. Y.
Taper Percent
(Based on 751 Trees)

Height Class in Feet	DBH Class	Actual Ht. in Feet	Actual DBH in Ins.	Diameter Measurements Expressed as Percents of DBH — At Points on Tree Bole above DBH expressed as % of distance between DBH Point and Top of the Tree										
				0	10	20	30	40	**50**	60	70	80	90	100
30	4	30.7	4.1	100.0	95.5	93.0	88.1	83.1	**78.2**	68.3	61.0	41.6	24.9	0.0
	5	33.3	5.0	100.0	96.2	92.3	85.9	82.2	**76.3**	68.1	60.0	46.2	22.1	0.0
	6	32.4	6.0	100.0	94.7	90.6	84.7	79.2	**74.6**	65.4	53.8	36.2	21.5	0.0
	7	31.9	6.9	100.0	94.4	90.0	88.6	79.9	**74.2**	71.1	62.3	37.6	21.9	0.0
40	4	40.4	4.3	100.0	95.6	91.0	86.2	81.4	**76.9**	69.6	55.9	42.0	20.2	0.0
	5	38.0	5.1	100.0	96.1	90.4	86.3	80.5	**72.5**	66.8	56.9	43.3	23.7	0.0
	6	41.1	5.9	100.0	95.1	90.0	86.7	81.4	**73.0**	67.8	55.9	40.7	22.1	0.0
	7	41.6	6.9	100.0	93.0	90.0	84.2	78.3	**72.6**	63.7	52.2	37.6	20.3	0.0
	8	40.7	8.1	100.0	93.8	88.7	83.7	78.9	**73.7**	62.0	51.9	36.7	24.1	0.0
	9	42.4	8.9	100.0	93.5	86.7	79.9	76.9	**73.0**	63.9	42.7	31.5	19.9	0.0
	10	41.0	10.0	100.0	90.1	86.0	79.0	76.0	**73.0**	64.0	45.0	31.0	21.0	0.0
50	4	48.0	4.4	100.0	95.5	91.2	88.7	86.6	**74.7**	68.3	50.0	31.9	18.9	0.0
	5	47.4	5.2	100.0	92.5	86.7	80.7	78.9	**71.3**	65.4	53.8	36.2	21.5	0.0
	6	48.2	5.9	100.0	95.4	93.5	90.1	79.6	**71.2**	64.5	54.3	40.7	22.1	0.0
	7	49.9	7.1	100.0	93.0	86.2	83.4	77.6	**71.5**	61.9	49.4	35.1	19.5	0.0
	8	50.5	8.1	100.0	95.4	91.4	84.2	78.1	**71.7**	61.7	51.9	38.3	22.3	0.0
	9	51.7	9.0	100.0	93.5	88.0	83.5	77.9	**71.2**	62.2	50.0	36.6	21.1	0.0
	10	50.6	10.0	100.0	89.0	83.0	80.0	75.0	**71.0**	58.4	48.0	34.0	21.0	0.0
60	7	59.3	6.9	100.0	96.9	88.7	81.3	73.9	**65.3**	55.1	44.9	36.2	18.9	0.0
	8	59.4	8.1	100.0	96.2	92.7	85.4	80.5	**70.4**	62.9	53.2	33.4	18.3	0.0
	9	58.6	8.9	100.0	94.3	89.9	85.4	77.4	**70.9**	60.7	50.6	33.7	18.0	0.0
	10	57.5	10.2	100.0	94.2	87.3	83.5	75.5	**69.0**	59.7	50.1	36.3	19.6	0.0
70	10	66.0	10.0	100.0	91.0	84.0	79.0	74.0	**67.0**	58.0	46.0	28.0	15.0	0.0

Note—The heavy line relatively indicates the approximate position of the base of the crown.

The important data to note in the two previous tables are the form ratios at the halfway points between the point DBH measurement and the tips of the trees. These for purposes of clarity and comparison are presented in Table III.

TABLE III

Table of Absolute Form Quotients For Swamp Spruce.
Township No. 2, McCombs Great Tract No. 2, St. Lawrence Co., N. Y.
Form Quotients (Based on 751 Trees)

DBH Class	Total Height Class of Tree in Feet					Averages for all DBH Class
	30	40	50	60	70	
4	78.2	76.9	74.7	....	....	77.0
5	76.3	72.5	71.3	....	....	72.9
6	74.6	73.0	71.2	....	....	72.9
7	74.2	72.6	71.5	65.3	....	72.2
8	....	73.7	71.7	70.4	....	72.0
9	....	73.0	71.2	70.9	....	71.4
10	....	73.0	71.0	69.0	67.0	70.4
Averages for All Ht. Classes.....	75.6	73.0	71.1	69.3	67.0	72.3

Form Factor values were constructed on the basis of the cylindrical breast height stem ratios. In other words the volume of the trees were compared with cylinders whose diameter was that of the breast height diameter and the length of whose longitudinal axis was equal to the total height of the tree. The tree volumes themselves were computed according to Schiffel's formula, i. e. $V = (.16B + .66b\frac{1}{2})h$. In Table IV as in Table III and in Table V, all averages computed either for height class or diameter class are weighted averages.

TABLE IV

Table of Cylindrical Breast Height Form Factors Swamp Spruce.
Township No. 2, McCombs Great Tract No. 2, St. Lawrence Co., N. Y.
Form Factors (Based on 751 Trees)

DBH Class	Total Height Class of Tree in Feet					Average Ff. in Each DBH Class
	30	40	50	60	70	
4	.567	.544	.528	....	....	.549
5	.559	.556	.502	....	....	.547
6	.530	.511	.497	....	....	.504
7	.526	.506	.492	.446	....	.498
8	....	.502	.498	.487	....	.496
9	....	.512	.492	.487	....	.495
10	....	.509	.494	.465	.462	.485
Average Ff. for each Ht. Class.......	.540	.517	.495	.474	.462	.506

A number of years ago a somewhat similar though briefer study was undertaken on the form of Balsam Fir.[2] A rather interesting point brought out in that study that independent of diameter class, height class, or age, there seemed to be a consistent difference or constant in the differences between the form quotient values and the form factor values. This constant varied in the 94 trees studied by Clarke from .213 to .222 with an average of .2187. A similar comparison has been made in this study of the form of the bole of Swamp Spruce which shows a variation in the value of the constant from .212 to .235 and an average of .2178, thus indicating a very close similarity of form in the two species. These results are presented in Table V.

TABLE V

Table of Constants or Consistent Differences Between The Absolute Form Quotient Values and the Cylindrical Form Factor Values in Swamp Spruce. Township No. 2, McCombs Great Tract No. 2, St. Lawrence Co., N. Y.

DBH Class in Inches	Constants					Averages
	30	40	50	60	70	
4	.215	.225	.219	....	....	.221
5	.214	.219	.212	....	....	....
6	.216	.219	.215	....	....	.221
7	.216	.214	.213	.217	....	.218
8	....	.235	.219	.217	....	.222
9	....	.218	.220	.222	....	.218
10	....	.221	.216	.225	.208	.219
Averages...	.216	.213	.216	.219	.208	.217

From the foregoing several conclusions may be drawn regarding the form ratios of Swamp Spruce.

1. Both form quotient values and form factor values vary inversely with increases in height and in diameter.

2. According to the conclusions of Jonson (1), Wallin (5) and others, this may indicate the keener competition due to crowding experienced by the smaller dimensioned members of the stand.

3. It is to be noted that the bigger the diameter the greater the relative length of the crown.

4. It is also to be noted the taller the tree the greater the relative length of the crown.

5. A deduction from the two preceding suggests that relatively long crowned trees develop more rapid taper and show lower form ratios.

6. This conclusion is born out in detailed examination of Tables

[2]The Form of the Bole of Balsam Fir, By Judson F. Clarke, Forestry Quarterly, Volume I, No. 2. January 1903, pp. 56-61.

I and II. There will be noted therein a very rapid diminution in the percentages once the bole has entered the crown.

7. A short stem with a high Form Quotient or Form Factor, will then indicate a relatively small crown, a relatively high crown, a large proportion of clear length, and a very rapid decrease in diameter or taper once the bole has entered the crown itself.

8. Conversely tall trees with rather low Form Quotient and Form Factor values seem to indicate, long, low, crowns, a small amount of clear length and rather easy but consistent taper of the bole within the crown.

9. From the preceding it would follow that thrifty, vigorous, and relatively faster growing trees are more conical in their tree form.

10. Comparison of these results with those of Clarke (3) show a surprisingly similarity between the two species.

11. Comparison of these results with those of Wallin (5), McVicker (6), Wright (8), Behre (7), and Baker (9), seems to indicate that the trees of this species follow approximately the same model as other North American species studied.

BIBLIOGRAPHY

1. Jonson, Tor; Massatakellar for Traduppskattning. Review of the same. Forestry Quarterly, Vol. XI, No. 3, Nov. 1913, pp. 399-400.

2. Mattson, L; Form Classes in Pine. Review of the same. Journal of Forestry, Vol. XV, No. 5, March 1917, pp. 665-666.

3. Clarke, Judson F., The Form of the Bole of Balsam Fir, Forestry Quarterly, Vol. 1, No. 2, Jan. 1903, pp. 56-61.

4. Fernow, B. E.; New Method of Measuring Conifers, Forestry Quarterly, Vol. V, No. 1, March 1907, pp. 29-35.

5. Claughton-Wallin, H., The Absolute Form Quotient, Journal of Forestry, Vol. XVI, No. 5, May 1918, pp. 523-534.

6. Claughton-Wallin, H. and McVicker, F., The Jonson "Absolute Form Quotient" as an Expression of Taper, Journal of Forestry, Vol. XVIII, No. 4, April 1920, pp. 346-357.

7. Behre, C. E., Preliminary Notes on Studies of Tree Form. Journal of Forestry, Vol. XXI, No. 5, May 1923, pp. 507-511.

8. Wright, W. G.; Investigation of Taper as a Factor in the Measurement of Standing Timber. Journal of Forestry, Vol. XXI, No. 6, October 1923, pp. 569-581.

9. Baker, F. S.; Comments on Investigations of Tapers as Factors in the Measurement of Standing Trees. Journal of Forestry, Vol. XXII, No. 1, January 1924, pp. 38-43.

CONTROL OF BARK BEETLES ON THE NATIONAL FORESTS[1]

By John F. Preston

U. S. Forest Service

Tree-killing insects of various kinds are always found in forests; they always have been and always will be present. The bark beetles are most destructive and are almost the only ones for which practicable means of control have been worked out. The genus Dendroctonus, including a great many species, has perfected a finesse of operation both remarkable in efficiency and amazing in destructiveness. It is this genus which so far has caused the heavy losses and with which the following discussion deals.

Classification of Insect Work:

Entomologists classify the status of insect attacks at any given time as endemic and epidemic. The first term means a normal number of bug-killed trees in the forest or an annual loss in virgin forests which may be expected and which does not ordinarily justify attempts to stop the damage. It may be expressed as a condition where the balance of nature is undisturbed—where the natural enemies of the bugs (parasites and predators) hold the number of bark beetles to a point where losses are at a minimum.

Under such conditions, there is no possibility of preventing severe losses except through the adoption of artificial control measures which, because of the expense, practical entomologists, except in some cases where timber values are very high, do not recommend. Under usual conditions in the National Forests, the cost of such control would be greater than the value of the timber saved.

Epidemic attacks on the other hand are those where the losses are greater than normal, where, for some reason which we do not yet understand, the balance of nature has been disturbed and the natural enemies of the bugs are no longer able to hold them in check. They consequently fly at will and often kill enormous quantities of timber. Under such conditions there is no alternative to artificial control of the insects except to take very severe losses. Sometimes other classifications are used to indicate the status of the attack, such for example as balanced epidemic where the losses from one year to the next are about equal, or increasing epidemic where losses are increasing.

[1]The author wishes to acknowledge the valuable assistance rendered by F. P. Keen and James C. Evenden, entomologists in the Bureau of Entomology in the preparation of this article.

Cycles:

Experience indicates that bark beetle epidemics go by cycles and that sooner or later every epidemic will run its course and the number of beetles will be reduced to an endemic status. The length of the cycle can not be foretold and neither can the probable loss. We know that one famous infestation in the Black Hills of South Dakota ran its course in about ten or twelve years, others are known to have lasted longer and shorter periods. The factors which determine the course of an infestation are not now definitely known. Apparently one important factor is the continuity of the timber body of the species suitable as a host. Frequently the new generation of beetles moves out of the immediate vicinity of the killed trees leaving a certain percentage of the trees untouched, perhaps in an effort to escape from their enemies. As long as unworked timber remains adjacent to the original epidemic area there is danger of continued spread. Other factors, of course, have great influence and any number of cases could be cited where the epidemic subsided with abundance of suitable untouched territory adjacent. Perhaps weather conditions have something to do with it and it is reasonable to suppose that they do, but there is little direct evidence so far to prove it. Mr. F. P. Keen of the Bureau of Entomology believes that there is some evidence to indicate that the altitudinal range of the tree species has a bearing on the problem; that the beetle is sometimes able to successfully attack only trees above or below certain contours where presumably the species is outside its *optimum* habitat and consequently its powers of resistance are weakened. Incidentally, if this theory proves to be correct, it may help to establish one limiting factor governing the occurrence of species and forest types—a problem which has given rise to many theories among foresters.

Life History:

The life history of all species of Dendroctonus is quite similar. The mature beetles, which emerge through the bark from the host trees, fly usually a comparatively short distance and bore into live trees of the same species as the host tree. It would appear from evidence in the field that the normal habit is for the beetles to fly short distances, not over a half mile, and usually not to exceed a few hundred yards. If the number of beetles attacking one tree is not sufficient or the tree is unusually resistant, enough pitch is exuded in the entrance hole to overcome and kill the beetles and the tree lives. However, the beetles have an uncanny way of attacking in force and few individual trees are

successful in defense. Once inside the bark next to the cambium the adult beetle digs a channel and lays eggs at intervals along it. In most cases the mating of male and female takes place under the bark. At any rate both male and female enter the tree and both assist in the housekeeping operations, consisting of throwing out sawdust and preparing ventilating holes through the bark. After the egg laying, the adult beetles have pretty generally completed their life task and either die immediately or in a few months. The eggs hatch shortly into white grubs and begin digging channels in the cambium usually at an angle to that of the parent beetle. The grub grows as it works, fattening upon the life tissues of the tree and together with the work of the parent successfully girdles the tree and causes its death. When the grub or larva is fully grown, it transforms into the pupa or quiescent stage which in turn shortly develops into the adult or beetle. When finally matured it digs an exit hole, or uses one prepared by another beetle, and repeats the destruction of its parent, augmented under epidemic conditions by greatly increased numbers.

The Black Hills beetle (Dendroctonus ponderosae) has only one brood a year and lives entirely in the cambium under the bark. Dendroctonus brevicomis on the other hand has several broods each year and lives *in* rather than *under* the bark. Many other minor variations occur in the life histories of the different species.

Recognizing Epidemic Conditions:

It is obviously of the utmost importance in the protection of the forest, for the local forester to be able to recognize the change in the status of the insect attack from "endemic" to "epidemic." The former condition usually calls for a policy of "watchful waiting" while the latter calls for an immediate report and action of some sort. As explained later whether or not it means actual control work depends upon the value of the timber being destroyed. Actually, entomologists are considerably "at sea" as to just what constitutes endemic and epidemic conditions and it is impossible to define exactly the point where the former leaves off and the latter begins.

From the practical viewpoint of forest protection, the exact line is not important. The "Forest Officer in charge" must determine the point where in his judgment the losses of timber are sufficiently noticeable to be alarming. Systematic observation of the same territory from year to year is usually sufficient to arouse suspicions or to allay fears. Occasional trees killed widely scattered throughout the forest is perhaps

the usual criterion of an endemic attack and need cause no alarm. It is necessary to arrive at this definition of endemic status for each separate forest and set of conditions. It is apparently not the same everywhere and certainly varies with each species of bark beetle. The local forester must take advantage of past experience by studying his forest for records of former attacks and he must, of course, seek the advice of experts whenever opportunity presents itself.

Any increased activity of the insects as shown by more frequent occurrence of infested trees and particularly a tendency to group infestation is the signal of danger and calls for an investigation. "The sudden springing up of newly infested trees, either singly or in small groups all over the forest, usually indicates an increase in the infestation."[2] All bark beetle epidemics do not show as increasing infestation from a center, usually known as the group method of attack, but where it does occur in this form, it is usually a sure indication of the epidemic status. This criterion may be used in the case of D. ponderosae and to some extent in attacks of D. brevicomis, but I understand it is quite infrequent in the over-wintering generations of the latter species. According to Mr. Evenden, the group attack is no indication of an epidemic in the case of the mountain pine beetle (D. monticolae). The best criterion, therefore, is the local forester's judgment that the number of infested trees indicates a rapid or abnormal increase irrespective of the occurrence of the infested trees in groups. Where they occur, the groups, in the worst epidemics such as that now existing in the Kaibab National Forest, often merge until nearly solid bodies of timber covering several hundred acres are killed.

Scouting:

One of the most important things to be done when epidemic insect conditions are found is to scout the territory to determine the extent of the attack. No man successfully fights a forest fire without finding out the size of the fire, the conditions in and surrounding it and where it is headed. Exactly those same facts must be determined for every insect epidemic before successful control can be inaugurated. The line of demarcation between the epidemic and the endemic stages must be established and the status of the epidemic area—that is, where it is increasing and where balanced and where heavy concentration occurs.

Every forester or forest ranger, or whatever his title may be, who is responsible for that particular forest property must become sufficiently

---

[2]Quotation from a letter received from J. C. Evenden.

familiar with the threatening attack to do this scouting. This is just as important in the protection of the property as is fire patrol. It requires some skill and experience and knowledge of the habits of the different species of Dendroctonus to spot the newly infested trees early in the season, but later on as the trees begin to die, the needles fade and gradually acquire sorrel or red tops. It is then too late, as a rule, to start control operation that season but the evidence is plain upon which to base a plan for control for the following season. The increase from year to year is plain and only awaits a systematic cruise to properly interpret the evidence.

Methods of Checking:

The forest officer, suspicious of the insect enemy should set about collecting evidence just as he collects evidence of any other form of trespass. Strip lines are run through the timber usually from 5 to 10 chains wide along which the losses of the past year and the current year are recorded. The same lines re-cruised for several seasons will tell the tale. In rapidly increasing infestations, one year's tally may be sufficient to establish the presence of the enemy and the need for immediate action. The strip lines, supplemented by thorough scouting, will furnish the information, in terms of number and sizes of trees attacked and of the total epidemic area, upon which to estimate the cost of control. The secret of success in insect control, as in fire protection, is to catch the damage in its early stages.

The Bureau of Entomology of the Department of Agriculture cooperates with the Forest Service and with private owners in the examination of infested areas and its experts furnish advice as to the cost and feasibility of control. The personnel of this Bureau, however, is limited and no forest owner can afford to wait for advice until the seriousness of the situation is forced to his attention by casual observation. Too often in the past when the entomological doctor was called in, the patient was in a serious condition, necessitating a major operation. Often too, the forest owner was in no financial condition to bear the expense of the operation and there was nothing to do but allow the patient to die. Home remedies applied early would have checked the destruction and prevented tremendous losses. There is no other way to successfully protect forests from insects. The responsible forest officer must continually be on the alert and able to diagnose the case, at least sufficiently to become aware that he needs expert advice.

Difficulties of Control in the National Forests:

The Forest Service has made some progress in detecting and stamping out incipient epidemics but too often they have assumed alarming proportions before being recognized. It is now fighting an epidemic in the Kaibab National Forest and the Grand Canyon National Park which covers over a hundred thousand acres. Failure to read the signs in the woods back in 1919 and 1920 and failure to scout and collect the evidence in that early stage has probably caused the loss of not less than 100,000 M feet of yellow pine and the expenditure of $50,000 in the attempt to stop the steady march of the army of destruction.

The reasons for the failure in this case, as in others, are many. Primarily, it is because forest officers have too often passed up protection against insects as something beyond their ken. They have become accustomed to seeing insect infested trees and are too prone to accept them as a necessary evil. They have failed to recognize that it was their job to distinguish between endemic and epidemic conditions and to take steps to stop the damage at a time when it could be accomplished at a relatively low cost. As a corollary of this situation it may be noted that the National Forests have been inadequately manned with trained foresters really competent to read the signs. Appropriations have not kept pace with the increasing intensity of management with the result that the Service has not been able either to employ in the field a sufficient force of trained men or to give the necessary training to much of the excellent material it has in its ranger force.

Several hundred thousand acres in charge of one forest officer can not be watched with the eagle eye which the value of the property justifies. In spite of all the care he can give, the insects may and often will get the upper hand before he realizes it. A great deal more could and must be done, however, by a changed attitude and an understanding of the responsibility involved, if the National Forests are to be saved from heavy losses.

An epidemic extending over several hundred thousand acres in the Missoula, Flathead, and Helena National Forests has been in progress for the last 15 years and shows no signs of abatement. The job of control is so big and the values at stake so small that very little can be done to hold it in check. The infestation must run its course. The epidemic of D. brevicomis in southern Oregon has been in progress for more than ten years and about $250,000 has been spent in the last three

years by private, State and Federal agencies in its control. The time to stop insect losses on a practicable scale is in the early stages, and it is the forester's job to recognize the epidemic stage or at least the dangerous symptoms of it.

Methods of Control:

The felling of the infested trees and the destruction of the insects while in the larva, pupa, or adult stage before flight, is the means adopted for controlling infestations. There is no way to save individual trees once attacked in force by the beetles. The method is aimed solely at destroying the broods while in the process of development in order to prevent the flight. Simply peeling the bark and exposing the insects to the sun and air while in the immature condition is sufficient to kill the Black Hills and the mountain pine beetles. Because they are found in the bark rather than under it, it is usually necessary to burn the bark of trees infested with Dendroctonus brevicomis. It has been found that exposure to direct sunlight where summer temperatures are high is sufficient to kill the broods of the latter insect but the period during which high temperatures prevail is so short and so uncertain that this method has not been used extensively. The method of control for each insect is adapted to its life history and the advice of an expert on this point should always be sought before beginning control operations.

The Percentage Theory:

The underlying idea in all artificial control measures is to reduce the number of beetles to a point where their natural enemies can hold them in check. In other words, to restore the normal balance of nature at once rather than wait for the infestation cycle to run its course and stand the loss which that entails. Dr. Hopkins[3] evolved what he called the percentage theory of control. His studies indicated that destruction of only a part of the beetles, leaving a sufficient number to feed the parasites and predators was more beneficial than the attempt to destroy a larger number. Complete destruction of all insects is a practical impossibility, so that it is merely a question of attempting to destroy 60 or 75 percent or 95 percent. The method outlined by Dr. Hopkins was to cut 60 or 75 percent of the infested trees on *all* parts of the epidemic area and leave to the parasites and predators the completion of the job.

One unfortunate feature of all artificial control work is that in destroying the beetles large numbers of their parasites and predators

[3]Dr. A. D. Hopkins, formerly chief of the Division of Forest Insects in the Bureau of Entomology and pioneer in the study of bark beetles.

are also destroyed, and it was in the attempt to encourage the multiplication of natural enemies of the beetles that Dr. Hopkins advocated the felling of not over 75 percent of the infested trees.

The control work carried out in the National Forests during the past few years has shown that the practical application of this theory is fraught with many difficulties. The results of attempts to leave part of the beetles (a percentage over the entire infested area) has not, as a rule, given satisfactory results. In the Kaibab work, areas where control was carried out in accordance with the percentage theory were heavily infested the following season, and on areas where the attempt was made to cut all infested trees there resulted very little new infestation the following season. I understand that similar results have been obtained on other control projects. On the other hand, some control projects carried out strictly in accordance with the Hopkins theory have apparently been successful. The Bureau of Entomology representatives in the western work now apparently agree that the surest way is to make just as clean a sweep as possible and to follow up the first control with maintenance work for one or more succeeding seasons. They emphasize more and more the importance of maintaining the ground gained, and preventing by artificial means at a time when control is cheap, the gradual rise of the infestation to epidemic proportions.

The Kaibab Theory of Control:

The rapid spread of the epidemic of the Black Hills beetles on the Kaibab National Forest from 1923 to 1924 and the consequent total inadequacy of the available funds to clean up the infestation together with the uncertainty of future appropriations, has necessitated the adoption of a plan which may give rise to a new theory or a modern adaptation of the old Hopkins theory. The peak of this epidemic is at the north end of the Forest where the beetles have moved from the mixed type of forest into pure pine. In this region the number of infested trees found varies from a few hundred to over 3,000 per square mile. The destruction here over considerable areas is nearly complete and the tremendous increase during the past year certainly gives no promise of a quick ending of the cycle without artificial control. Studies of the infestation farther south where the epidemic conditions have prevailed for several seasons indicate that the insects are less rabid here than at the extreme north end and give some hope that the peak has already passed and that the natural

enemies of the beetles will be able to check the destruction. Mr. Keen of the Bureau of Entomology, who is in charge of technical strategy of the work, advances the theory that the most husky and daring members of the tribe are the pioneers and these make the inroads into new territory, leaving the sluggards and less husky individuals to mop up in the rear. His theory is that since we haven't enough money to make a clean sweep of the entire area there is an opportunity to hit a death blow to the pioneers on the front line and trust to the parasites and predators to subdue the rear.

The plan of attack is, therefore, to make a clean sweep of 14,000 or 15,000 acres at the north end and extending south and west in a strip two miles wide. If results seem to justify this strategy, maintenance control will be carried out in succeeding years in the same area to catch and subdue the advance guard and prevent it from crossing the frontier or dead line thus established. If it succeeds, control will be cheaper than any attempt to sweep clean the entire epidemic area but the timber losses will be heavier. However, on this Forest which is located on the north rim of the Grand Canyon the commercial value of the trees is very low and does not justify expensive control measures. It will be seen that this theory is fundamentally the same as the one originally proclaimed by Dr. Hopkins, but the application of it is vastly different.

When is Control Justified?

Artificial control is always justified when the job is small and the epidemic is increasing. When the epidemic has already covered large areas before the seriousness of the situation is realized the advisability of control work will hinge on the question of values—the cost of control as against the timber values to be saved. Usually where the job is big, the epidemic has already reached a peak before control operations begin and will surely decline in the future. Control operations have recently cost from $3.00 to $5.00 per M feet for the trees actually felled. Such work has undoubtedly reduced the annual loss to one-half of what it would have been without control. Figuring the average epidemic cycle at ten years, it could be figured to run another five years after the peak, or five years' losses at the current rate could be used to estimate the probable loss without control. If the current loss is 200 board feet per acre per year, the loss in five years would be 1,000 board feet. One-half could be saved by control work or 500 board feet. The control at $5.00 per M feet would cost $1.00 per

acre; at stumpage values of $2.00 per M feet the saving in timber would just equal the cost of control without considering the cost of maintenance and the risk of failure. Any stumpage values exceeding $2.00 per M feet would probably justify control measures. It is purely a question under such conditions of balancing control costs against conservative estimates of timber values to be saved. In general, it may be said that where stumpage values are approximately equal to the cost per M feet of the control work, the timber saved will amply justify the expenditure and where stumpage values are $2.00 or less, control work can not be justified solely from a commercial viewpoint. Experience has taught the further lesson that it is useless to deal gently with an insect epidemic; it must be hit a good hard blow or the money is wasted. Furthermore, the ground gained must be held just as in fire fighting. Insect control involves the first heavy blow and expenditures on a smaller scale for at least several succeeding seasons until the epidemic is reduced to endemic.

Records of Past Control Work:

Insect control work has been carried on by the Forest Service on a small scale since 1906, when a few thousand dollars were spent in an effort to stop the infestation in the Black Hills of South Dakota. Until the Fiscal Year 1924 there was no regular appropriation made for this activity and consequently the money had to be obtained by squeezing it from other activities or by special appropriation from Congress. By and large the accomplishment has probably been very small because, in most cases, the blow struck was too feeble. A great deal of valuable experience was obtained however, and the results both negative and positive were worth while experiments from which the Bureau of Entomology has learned much to guide the future work.

Beginning with the Fiscal Year 1924 the agricultural appropriation bill authorized the expenditure of $25,000 of the fire-fighting fund for controlling insect infestations and this authorization was repeated in the bill for the year 1925. This will enable the Forest Service to take an entirely different attitude toward insect control. Heretofore, it has been forced, through lack of funds, to side-step the insect problem as much as possible. Now it can go after it aggressively in the attempt to prevent large losses rather than simply to save something out of the wreck.

The largest project so far undertaken is the southern Oregon-Northern California project, which was a cooperative effort by Federal,

State and private owners under the technical direction of the Bureau of Entomology and for which Congress appropriated $150,000 available over a three-year period. The third year's work is now almost completed and the project has been put on a maintenance basis. This belongs to the class of projects previously mentioned where the epidemic had already reached a peak before control work began. For the Kaibab-Grand Canyon project, a special appropriation of $25,000 was made this year. This is also the third season for this work but at no time has there been available enough money to really strike a telling blow.

Statistics recently compiled of insect control activities of the Forest Service up to and including the calendar year 1923 are shown in the following table:

Calendar Year	Total Volume Treated M. ft. B. M.	Total Amount Expended	Cost per M. ft. B. M. (for treated timber)
1906	300	$2700	$9.00
1907	450	2589	5.50
1908	1,000	2500	2.50
1909	?	50	?
1911	4,284	24452	5.70
1912	2,298	15040	6.54
1913	7,090	23434	3.30
1913	?	446	?
1914	6,670	22452	3.36
1915	1,959	7939	4.05
1916	4,929	10535	2.14
1917	4,536	15004	3.30
1918	823	2557	3.11
1919	355	2502	7.05
1920	1,546	9735	6.29
1921	4,285	20905	4.88
1922	17,622	74082	4.20
1923	19,284	68381	3.54
Total	77,431	$305,303	$3.93
By Districts			
1	4,390	$ 20,475	$4.55
2	2,489	15,079	6.01
4	6,563	18,585	2.83
5	29,013	103,490	3.57
6	34,974	147,674	4.22
Total	77,431	$305,303	$3.93

Insect Losses:

It is, of course, very difficult to even estimate the annual loss of timber from insect attacks and any statistics attempted are interesting

rather than useful or accurate. Furthermore, much of the loss is from endemic infestation which can not be controlled under present economic conditions. It is easy to figure an annual loss of not less than 500 million feet on the National Forests which, if given a value equal to that of National Forest timber cut for the last five years, would easily equal or exceed the annual loss from forest fires for the same period. The following paragraph explains the basis for this estimate.

An insect survey was made in California in 1917 by the Forest Service in cooperation with the Bureau of Entomology and the National Park Service covering an area of 1,682,600 acres, mostly virgin forest. This area contained 19,307 million feet of timber or 18 percent of the total timber stand in the State. The calculated loss for that year was 25,570 M feet of yellow and sugar pine amounting to .13 of 1 percent of the stand or about 15 board feet per acre. Mr. J. C. Evenden of the Bureau of Entomology estimated that the loss of white pine on the Coeur d'Alene National Forest in 1918, which was considered to be a subnormal year, was .3 of 1 percent of the total stand. On the basis of a total stand all species of 4,000 million feet on 660,000 acres this would represent a loss of about 18 board feet per acre per year. Mr. J. C. Miller also of the Bureau of Entomology, in his first annual report on the San Joaquin project, Sierra National Forest, gives the annual endemic loss of yellow and sugar pine as .1 of 1 percent of the total pine volume. Mr. A. E. Weislander of the Forest Service in a management plan for the eastern Lassen Working Circle, Lassen National Forest, estimated the loss from insects on the 170,000 acres included in the circle as 50 board feet per acre per year. The total stand of yellow, sugar, jeffrey, white and lodgepole pine and spruce on the National Forests is roughly estimated to be 215,000 million feet. These are the species most subject to insect attack and which have suffered most severely from endemic infestation. At .1 of 1 percent the loss would be 215,000 M feet, or at .2 of 1 percent 430,000 M feet.

The Ultimate Solution:

A loss of somewhere between $500,000 and $1,000,000 annually due to insect depredation on the National Forests would seem to be a conservative estimate. In spite of this enormous loss, it is useless to talk of trying to stop any considerable portion of it. It can not be done; at least no practicable method is known which would not cost more than the timber saved would be worth. The above figures represent largely losses from insects in the endemic status scattered over the

entire belt of National Forest timber throughout the West. We are absolutely helpless before the insidious attacks of this foe and we must pay the annual toll demanded. It is a common saying among foresters that in virgin mature timber, growth is largely offset by decay. Bark beetles are one of the reasons why this is so. While we must be content to pay the annual toll due to endemic insect attacks the same statement does not apply to the epidemics. Where concentration occurs and the gorillas mobilize in force it is practicable to fight back. As already explained, it is then wholly a question of the values at stake.

The timber in the National Forests, is at the present time, still largely inaccessible and of low sale value, and only a very extensive form of management is in effect. When the demand for this timber increases to the point where reasonably intensive management is possible the situation will be different. It is different now in isolated spots and regions. When a field officer has only 50,000 acres to look after instead of 250,000 acres, the job of watching the insects will not only be easier but it will entail little expense for control. The removal of the sustained annual yield will gradually replace the present overmature stands with a growing stock of young timber better able to resist the insects. The annual cutting operations will furnish freshly cut logs to attract and feed the hungry broods whose destruction will usually follow. The elasticity of the cutting program will enable the forester to shift the logging so as to check any threatening epidemics. From present indications, the day of intensive management for our heavily timbered National Forests is not distant more than 20 years.

It is some consolation to know that we will not always have an insect problem comparable to that which we now face. In a well managed and intensively used forest the toll which the insects can take will be very small. Insect species can perhaps never be exterminated, but certainly the waste of timber which they cause can be and will eventually be stopped. Meanwhile it is the forester's job to do what he can to prevent the heavy and spectacular losses and he must not side step the problem. I want to again emphasize the statement that the control of insects is primarily the forester's job; the technique of methods must be prescribed by the entomologist, but the responsibility for the protection of the forest against insects must rest squarely upon the forester's broad shoulders. Will he be able to carry the burden?

ARTIFICIAL REPRODUCTION OF CALIFORNIA NUTMEG

(Torreya californica Tor.)—(Tunion californicum Greene)

By Woodbridge Metcalf

Assoc. Prof. of Forestry, Univ. of California

California Nutmeg (*Torreya californica*) is a comparatively rare and little known species of forest tree which occurs in small groups or as individual trees scattered here and there throughout the redwood region of the California coast. When associated with redwood it is usually a tree of moderate size, being 2½-3 feet in diameter breast high and 60-70 feet tall, though much larger individual specimens are occasionally found. One area near Swanton in the Santa Cruz mountains contains several trees which are over four feet in diameter and about one hundred feet in height. A tree growing near the Ross camp on Big River, Mendocino County, on bottomland originally covered with big redwoods is 47 inches DBH and slightly over 100 feet tall. The tree was probably left by early loggers and is now surrounded by a growth of red alder and California laurel, which trees are practically the same height as the nutmeg. An increment boring in this specimen, which is a staminate tree, showed it to be growing in diameter at the rate of ⅜ inch per year. The species occurs as a small tree or many branched shrub in brush fields of the coast mountains and again in sheltered canyons and on slopes of the central Sierra Nevada mountains. The yew family (*Taxaceae*), to which it belongs, is characterized by its berry-like or olive-like fleshy fruits which contain but one seed, and its narrow linear evergreen leaves which are green both above and below instead of having white lines of somata on the lower side as do other linear leaved western conifers.

IMPORTANCE OF THE TREE

The California Nutmeg has two characteristics which give it considerable silvicultural interest and which may make it of great commercial importance in the future. It sprouts vigorously from the stump as does redwood and during the younger stages makes practically as rapid growth as the latter species. This ability to sprout and grow on even terms with redwood second-growth seems to warrant rather extensive use of the tree as a filler among clumps of redwood sprouts if seedlings can be grown at a reasonable cost.

The wood of California Nutmeg has never been manufactured in any quantity because of the scattered occurrence of the trees, but it has qualities which indicate that it is admirably suited for many special purposes. It is light yellow brown in color; strong and remarkably smooth in grain and texture. Pieces having very wide annual rings show practically no difference in wood structure between spring and summer wood. This coupled with the fact that it works easily without splintering and seasons quickly with a minimum of checking, makes the wood ideal for pattern work or carving. The wood has a delicate fragrance quite similar to the odor of sandal wood and is among the two or three most durable woods when in contact with the soil. Logs of nutmeg have been found near Swanton which were in perfect condition after lying on the ground for over a hundred years. In many respects nutmeg wood is similar to that of Port Orford cedar but without the sometimes objectionable odor of the latter species.

Freshly sawn boards have a bright canary yellow color which fades during air seasoning to an almost chalky gray white. This gives a pile of nutmeg lumber a very distinctive appearance. The wood when air dry weighs about 28 lbs. per square foot and is so highly prized by mill men for cabinet work in their homes and by repair shop men for patterns and templets that they sometimes endeavor to hide it from each other. Trees are occasionally cut in Mendocino County which yield clear boards 20 inches wide and 14 feet long. If the lumber can be produced in considerable quantities in the future, there is every reason to suppose that it will command a very high price—perhaps higher than that obtained for any other western wood.

In view of the above facts, experiments have been carried on for several years at the Forestry Division nursery in order to determine the characteristics and requirements for germination of Torreya seeds and the suitability of the tree for use in reforestation. This study was made possible through the kindness of Mr. R. E. Burton of Santa Cruz who for the past three seasons has personally supervised the collection of seed. All of this was collected from trees of typical form growing near Swanton in the Santa Cruz mountains.

THE SEED

The California Nutmeg is among the few American gymnosperms which have male and female flowers on separate trees. This dioecious character makes it imperative that trees of both sexes be growing in close proximity in order that viable seed may be produced. This fact

has undoubtedly been one contributing cause of the scattered occurrence of the species. Another is the extreme size and weight of the seed which is larger and heavier than the seed of any other gymnosperm on the North American continent. In late October or during November when the fruits are fully mature they have the appearance of large, bright green olives flecked with purple streaks and are usually 1¼ to 1½ inches long by about 1 inch broad. The seed itself is about the size and shape of a thin shelled pecan nut with one end blunt and the other pointed. The seed coat is thin, smooth and is light brown or nearly white when separated from the pulpy mesocarp and allowed to dry. The fleshy covering can be removed from the seeds by gently macerating the fruits in water but great care should be used to prevent cracking the seed coat. In each lot of seeds a few have been found in which growth at the large end has not completely closed the seed coat. These should be discarded as they usually do not germinate. After removal of the mesocarp the seeds of each lot were slightly dried and shipped at once.

SIZE AND WEIGHT

Fifteen seeds of the 1920 crop picked at random from a lot of fifteen or twenty pounds were carefully measured shortly after being received at Berkeley with the following results:

	Maximum Inches	Minimum Inches	Average Inches
Length	1.55	1.10	1.36
Width	1.05	0.75	0.92
Thickness	0.95	0.70	0.82

When fully saturated with water the seeds weigh approximately 9 grams each or about 50-52 per pound. This was determined by weighing several lots of seed of the 1920 crop after soaking for 11 days and is probably about what the seeds weigh immediately after removal from the fleshy outer coat.

When allowed to season at room temperature the seeds lose from 30% to 50% of the moisture they contain just after collection. This is shown by the following table.

Loss of Moisture in Seasoning California Nutmeg Seeds

Date Collected	Date Weighed	Container	No. Seeds per lb.	Loss of Moisture % of green wt.	Cutting Test
Nov. & Dec., 1920	Jan. 18, 1921	Saturated	52	00	95%
Nov. & Dec., 1920	Jan. 18, 1921	Screw Top Can	72	27.6%	
Nov. & Dec., 1920	Jan. 18, 1921	Paper Bag	94	44.6%	
Nov. & Dec., 1920	Dec., 1921	Paper Bag	98	46.3%	71%
Nov., 1921	Dec. 16, 1921	Burlap Sack	77	00	96%
Nov., 1921	Oct. 5, 1922	Stratified in soil	70.4	(— 8.8% gain)	
Dec., 1922	Jan. 10, 1923	10 days in Burlap Sack	79	00.0	85%
Dec., 1922	Feb. 6, 1923	Burlap Sack	103.5	23.4	
Dec., 1922	Mar. 5, 1923	Burlap Sack	108*	28%	

NOTE—Weights in each case were not obtained until 10-20 days after collection during which period probably some loss of moisture occurred. The figures 72, 77, and 79 seed per lb. are comparable and show that the seed of different years is quite uniform in weight.

*In this air dry condition the seed coat was found to make up 25.7% of the total weight.

EFFECT OF STORAGE ON VITALITY

It is necessary to place Torreya seeds in the soil as promptly after collection as possible. This may be done either by sowing in drills or broadcast in regulation seed beds or storing in a shallow pit for ten to eleven months. Storage at room temperature for a like period gave negative results with seed of the 1920 crop, although several samples were soaked in water and in moist sphagnum moss to restore the original moisture content before sowing.

Pit storage of seed of the 1921 crop gave somewhat better results after ten months than the method of sowing directly in beds. Twelve pounds (approximately 924 seed) were stratified on Dec. 16th, 1921, under 3″ of soil. When removed on Oct. 5, 1922, a few seeds were found to have been destroyed by rodents, but 803 apparently good seeds (87% of those placed in storage) were removed from the pit and planted in beds. A total of 830 seeds of the same lot sown in seed bed drills on Jan. 3, 1922, and covered with ¾″ to 1″ of sand were dug up and inspected Oct. 26, 1922. Only 215 good seed (26%) remained. The large loss in these was probably due to excessive drying out during the summer months. Pit storage is greatly to be preferred because it saves seed bed space and seems to keep the seed in much better condition.

Development of the embryo from an almost microscopic spot near the large end of the seed to a length of over ¼″, takes place during the ten to twelve months of storage. For the next two months its growth is more rapid and when the shell cracks for emergence of the root tip two well developed cotyledons are present. These have forced their way through the cocoa-nut like endosperm until they are nearly as long as the total length of the seed. An interesting feature of these cotyledons is that they contain chlorophyll of bright green color though still firmly embedded in the endosperm. Light is therefore not necessary in the formation of this chlorophyll but the green matter is apparently necessary in the absorption of food from the endosperm.

The seed when germinating always cracks open at the large end from which the root tip emerges. Growth at this stage takes place largely in the base of the cotyledons which elongate so that the plumule or growing point is well outside the seed before it starts to develop into the shoot. Seeds must be well covered, as the plants just after emerging from the seed coat are very tender and subject to damage by drought or frost. It is inadvisable to sow the seeds in a vertical position with the pointed end down as, if the soil covering is not of sufficient depth, the tender root tip emerges into the air where it dies out and causes the death of the plant. This was well demonstrated by comparative tests with seed of the 1920 crop.

(1) Horizontal position—330 seed sown Dec. 1920—produced 184 trees Sept. 1922=55.7%.

(2) Vertical position—150 seed sown Dec. 1920—produced 42 trees Sept. 1922=28%.

The low tree percent from vertical sowing was largely due to high mortality from unusually severe frosts during Feb. 1922. The seeds were germinating just at this time and the vertical position brought the tender root tips too close to the top of the ground.

TIME OF GERMINATION

California nutmeg seeds require a long period of rest after maturity before they will germinate. This period is from 12 to 15 months and it has not been possible thus far to hasten germination by soaking, acid or warm water treatment, or the use of freezing temperatures. The length of time necessary for germination is shown in the following table.

Seed Year	Date of Sowing	Date Germination Started	Germination in Full Progress
1920	Dec. 29, 1920	Nov. & Dec. 1921	Mar. & Apr. 1922
1921	Dec. 16 & 29, 1921 and Jan. 3, 1922	Jan. 1923	Mar. & Apr. 1923

Several hundred seeds of the crop of each year were planted in the above tests and each time only one seed germinated during the first growing season.

Apparently it is useless to sow seeds which have become cracked in transit or which have defective shells for any reason. The long period of 14 months in the soil before germination begins makes the seed very susceptible to damage by insects and fungus disease unless the protective seed coat is intact. On Jan. 4, 1921, 187 seeds with cracked or imperfectly developed seed coats were sown. The bed was dug up and the seeds examined on Feb. 21, 1922. Only six good seeds were found. Five others germinated and grew into good trees during spring of 1922, or a total of 5.9%. Approximately 150 seed of the 1921 crop having cracked shells were sown Jan. 3, 1922. When dug up and examined on Oct. 20, 1922, not a single good seed could be found. All had been destroyed by fungus or insect action. It is therefore advisable to sort out and throw away any seeds which do not have a perfect seed coat.

GROWTH IN SEEDBEDS

The nutmeg seeds have in each case been sown in standard 4′x12′ seedbeds in drills 4 inches apart. Fifteen seeds were sown per row and this gives rather open spacing of seedlings. Sowing twenty to twenty-five seeds per row should give ample space for development and insure better utilization of seedbed space. The Caspar Lumber Company grew a considerable number of seedlings from 1920 seed in seed flats six inches deep and about eighteen inches square. Apparently these boxes were not deep enough for adequate root development as the seedlings did not make as sturdy growth as those sown in seedbeds.

After emerging from the soil, nutmeg seedlings make rapid growth and will average three inches in height six weeks after germination. During this stage in open seedbeds they have a reddish brown color and seem to be lacking in chlorophyll. This is probably because they

are drawing practically all their food from the seed. Later in the summer when the stored food supply is exhausted the leaves assume a normal bright green color. In beds where half shade is given during the spring the brownish color is not so noticeable.

Any seedlings which are broken or injured during the first spring immediately sprout from below the point of injury and grow a new stem.

At the end of the first growing season the seedlings will average four to six inches in height. They have a sturdy stem, and a well developed fibrous root system which is not too deep for easy handling in transplanting or setting out in the plantation. The roots are bright yellow in color which distinguishes them from all other common coniferous seedlings.

The average tree percent ($\frac{\text{number of seedlings}}{\text{number viable seed sown}}$) will probably average about 60 under optimum conditions but may be much less than this.

Date of Sowing	No. Seed Sown	Date Counted	Trees Produced	Tree Percent
Dec. 1920—Horizontal	330	Sept. 1922	184	55.7%
Dec. 1921	846	May 30, 1923	126	15%
Oct. 1922 } Stratified	540	May 30, 1923	373	69.0%
Oct. 1922 } Dec. 1921	242	May 30, 1923	143	59.0%

PROGRESS OF GERMINATION

Typical progress of germination of California Nutmeg seeds is shown by the following record of one lot of the 1921 crop:

Nov. 22, 1921. Seeds received at Berkeley.

Dec. 16, 1921. Seeds stratified in shallow pit.

Oct. 5, 1922. Seeds removed from pit and 540 planted in seedbed No. 3.

May 5, 1923. Germination in progress, 40 above ground.

April 7, 1923. Counted 313 above ground.

May 1, 1923. Counted 366 above ground.

May 30, 1923. Counted 373 good seedlings plus 9 albinos.

Tree percent on May 30=69%.

Percent of albinos=1.6% of seeds sown.

ALBINISM

In each lot of seed sown thus far a small percentage of seedlings develop without chlorophyll. These albino seedlings grow

vigorously for the first few weeks but soon the top dies and often several other stems will be produced from basal buds before the endosperm is exhausted and the seedling dies. From the 1920 seedling there were fourteen albino seedlings or 4.2% of the seed sown. These were in addition to the tree percent of 55.7 shown in the above table. The percent of albinos in the 1921 seed averaged 1½% on May 30, 1923. The tendency to albinism may be characteristic only of the Santa Cruz seed and may not appear in seed collected from other localities. In any event it seems unlikely that the loss of seedlings from this cause will be more than 5%.

AGE OF STOCK FOR PLANTING

A total of 226 thrifty trees was produced from the seed of 1920. These were dug from seedbeds in October 1922 and 70% were large enough for planting directly in the field. Seventy-five of these trees were shipped to Fort Bragg for experimental planting, the rest being set out in the Berkeley Hills. Sixty-nine of the smaller trees were set in transplant rows. The work of transplanting and planting in the field was done by students during the last week in October and the first week in November, 1922. A period of dry weather followed before heavy rains, and the long drought of February and March, 1923 was very hard on all these trees. After the rain of April 1 an inspection of the 69 trees in the transplant area showed a survival of 52% which is probably a minimum figure because of the character of the stock and the extremely unfavorable weather conditions.

Twelve of the seedlings sent to Fort Bragg were set in the nursery there November 15, 1922. V. Davis reports that on May 15, 1923, all of these were alive, ten being thrifty and two doubtful.

SURVIVAL IN PLANTATIONS

The survival of nutmeg trees in plantations must be based entirely on the experience during the past winter and spring which was most unfavorable for planting operations because of the drought of February and March. In spite of this unfavorable weather the seedlings planted appear to be in very good condition as shown in the following table:

Nutmeg Plantations

Locality	Date Planted	No. of Trees	Survival May, 1923
North Fork Noyo River Mendocino County	Nov., 1922	10	Thrifty 30% Growing 40% Doubtful 30%
Strawberry Canyon Alameda County	Oct. 12, 1922	26	89% (Feb. '23)
"	Nov. 11, 1922	20	*10%

*These plants were taken up from seedbed on Oct. 15th, packed in moist sphagnum and stored at a temperature of 45° F. to await better planting conditions. If they had been dug immediately before planting the survival percent would undoubtedly have been much higher.

COST OF GROWING TORREYA SEEDLINGS

Because of the large size of the seed, California Nutmeg will probably be more expensive to grow than most other western trees. The seeds have cost about 40c per pound to collect and have averaged 70 seeds per pound when sown. Figuring an average tree percent of 60 the cost may be estimated about as follows:

	Cost per tree
Seed cost	.01
Nursery cost at 400 trees per bed	.01
Transplanting cost on 30% of trees	.005
Digging and packing	.005
Total nursery cost	.03
Shipment and field planting costs	.01
Total cost per tree	.04

Figuring a loss of 20% in plantations it would cost about $20.00 per acre to establish 400 trees per acre between clumps of redwood sprouts.

It is believed, if the trees make rapid growth under plantation conditions, that the probable high value of the lumber produced will warrant extensive use of this species and it is entirely possible that, on a large scale, seedlings can be produced somewhat more cheaply than indicated above.

THE USE OF THE MEDIAN IN ESTIMATING STANDING TIMBER

By Amihud Grasovsky

University of California

In the science of statistics three types of averages are recognized; the arithmetic average (with which we are all familiar), the median, and the mode. The median is defined as the middle item of an array or column of figures arranged in order of their magnitude. The mode is the most frequent size of items.

For example suppose a sample plot contained 9 trees with the different diameters arranged in the order of their magnitude, as follows:

	DBH Inches
	10
	10
	10
	11
	11
	12
	13
	13
	14
Total	104

The arithmetic average is obtained by adding diameters and dividing by the number of trees; 104 ÷ 9 = 11.5.

The median tree is the fifth tree in order of magnitude, and its diameter is 11.0 inches. The formula for finding the number of the median tree is $\frac{n+1}{2}$ where n is the number of instances (trees). In this case it is $\frac{9+1}{2}=5$.

The mode is 10 because there are more 10 inch trees than there are of any other size.

In forestry the arithmetic average alone has been widely used, probably because it lends itself to simple arithmetic computations. The median, however, has a number of advantages among which is the fact that it is much more easily determined. In the above example, to secure the arithmetic average, the diameters of all the trees in the plot had to be taken. In determining the median diameter, however, the

size of the larger and smaller trees does not enter into the computations, and measurements can be restricted to a few trees in the diameter class in which it may be foreseen that the median will fall. The importance of this is, of course, far greater where a larger number of trees are involved.

The present paper suggests a method by means of which the median may be substituted for the arithmetic average in estimating sample plots. It is based on the fact that while the median and the arithmetic average ordinarily are not the same there is for a given species a close correlation between them, so that if one is known the other may be readily determined.

To estimate a plot by this method the first step is to determine the median tree. This is done by taking the DBH (to inches or preferably tenths of inches) of only those trees whose diameters are in the classes in which the median is expected to fall, merely counting all of the smaller and larger trees. The number of trees whose DBH must be measured can be reduced greatly as experience in estimating the approximate value of the median is gained. The resulting tally sheet would appear somewhat as follows:

DBH Inches	No. of Trees	Cumulative Total
Under 8.0	27	27
8.1	3	30
8.2	0	30
8.3	1	31
8.4	4	35
8.5	2	37
8.6	0	
8.7	1	
8.8	1	
8.9	1	
Over 9.0	31	
Total	71	

Median[1] $= \frac{n+1}{2} = \frac{71+1}{2} = 36.$

Therefore the median is the 36th largest tree, and its DBH is 8.5″.

A high correlation between median and arithmetic average in even aged redwood stands is seen in the following table and computations. The data were compiled by the University of California For-

[1]W. I. King. "Elements of Statistical Methods," Sec. 87.

estry School in Sonoma, Mendocino, and Humboldt Counties, California. The "arithmetic average DBH" used in this case is the DBH of the tree of average basal area, a more useful value for computing volumes.

Degree of correlation is best measured by the so-called coefficient of correlation suggested by Karl Pearson.[2]

The formula is: $\frac{\Sigma(d_x d_y)}{n o_x o_y}$ where $\Sigma(d_x d_y)$ is the summation of the deviation of arithmetic averages from their mean times the deviations of the medians from their mean. n is the number of instances, o_x is the standard deviation of arithmetic averages, o_y is the standard deviation of the medians.

The formula for the standard deviation [3] is $\frac{\Sigma d^2}{n}$ where Σd^2 is the summation of the deviation from the mean squared, and n is the number of instances.

The standard deviation of a series of values is computed by obtaining their arithmetic average, calculating the difference between each item and this arithmetic average, squaring these differences, summing these squares, dividing the sum by the number of values in the series, and lastly extracting the square root. The underlying theory may be found in texts on statistics, as W. I. King "Elements of Statistics," Sec. 84.

Perfect correlation is indicated by a coefficient of correlation of 1.0 while when the coefficient of correlation is 0.0 there is no correlation at all. A coefficient of correlation above .60 is considered an indication of close correlation.

The coefficient of correlation must also be six times greater than its probable error[4] to assure a dependable correlation. The probable error is readily determined by the formula $\frac{r = .67\ (1 - r^2)}{\sqrt{n}}$, where r is the coefficient of correlation, and n is the number of instances on which it is based.

The method of computing standard deviations, coefficient of correlation, and its probable error may be more easily understood by reference to the following table:

[2] Bowley. "Elements of Statistics." Part II, Sec. VI.
[3] H. Secrist. "An Introduction to Statistical Methods." Page 400.
[4] Bowley. "Elements of Statistics." Part II, Sec. VI and VII.

THE COEFFICIENT OF CORRELATION

Plots averaging .3 acres in even aged redwood.

No. of Plot (n)	DBH Av. tree based on b.a. inches	Deviation from the average (d_x)	(d_x^2)	Median Inches (M)	Deviation from the mean (d_y)	(d_y^2)	(d_xd_y)
1	20	6	36	18	6	36	36
2	23	9	81	20	8	64	72
3	20	6	36	20	8	64	48
4	21	7	49	18	6	36	42
5	16	2	4	15	3	9	6
6	15	1	1	11	1	1	1
7	8	6	36	6	6	36	36
8	16	2	4	14	2	4	4
9	12	2	4	10	2	4	4
10	12	2	4	7	5	25	10
11	15	1	1	16	4	16	4
12	19	5	25	16	4	16	20
13	11	3	9	6	6	36	18
14	6	8	64	5	7	49	56
15	12	2	4	11	1	1	2
16	10	4	16	9	3	9	12
17	12	2	4	11	1	1	2
18	13	1	1	12	0	0	0
19	10	4	16	10	2	4	8
20	11	3	9	11	1	1	3
	$\Sigma=282$ Av. $=14.1$ Approx. 14		$\Sigma d_x^2=404$	$\Sigma=246$ Av. $=12.3$ Approx. 12		$\Sigma d_y^2=412$	$\Sigma(d_xd_y)=384$

The standard deviation. $= \sigma = \sqrt{\frac{\Sigma d^2}{n}} = \sqrt{\frac{404}{20}} = 4.5$

The standard deviation. $= \sigma_1 = \sqrt{\frac{\Sigma d^2}{n}} = \sqrt{\frac{412}{20}} = 4.55$

$$\text{The coefficient of correlation} = r = \frac{\Sigma(d_xd_y)}{n_x\sigma_x\sigma_y} = \frac{384}{20\times4.5\times4.55} = .95$$

$$\text{The probable error of (r)} = e = .67\times\frac{(1-r^2)}{\sqrt{n}} = \frac{.067}{4.47} = \pm .018$$

$$\text{Therefore } r = .95 \pm .018$$

Having established that there is a very high correlation between the median and the arithmetic average it remains to express the interrelation existing between them in such a form as to enable us to determine one if the other is known. This could obviously be accomplished graphically by plotting the values for the median DBH over

those for the arithmetic average as is indicated in Fig. 1, and drawing a curve or straight line through these plotted points. Statistics, however, offer a more accurate method involving the use of what is known as the ratio of regression, which is based on the theory of least squares, and gives the mathematically most probable position of a straight line fitted to the points plotted.

The formula for the ratio of regression is: $R = r\frac{o_x}{o_y}$ where R is the ratio of regression, r is the coefficient of correlation, o_x is the standard deviation of the arithmetic average, o_y is the standard deviation of the median.

The resulting value is the slope of a straight line passing through the point on the graph which represents the intersection of the mean of the arithmetic averages and the mean of the median. This point is indicated in the graph by the intersection of the vertical and horizontal broken lines. In the present instance $R = \frac{.95 \times 4.50}{4.55} = .94$.

The resulting straight line in the graph is shown by a dotted line. While this does not pass through the origin, it can be shifted to the origin as indicated by the solid line without any serious alteration in its values. This will make it possible to substitute for the use of the graph the easily remembered correction factor 1.13 (the slope of the solid line in Fig. 1). The error involved is negligible for all practical purposes.

In this example diameters were measured to the nearest inch though measurements to tenths of inches would have given more accurate results. Owing to the great variation in age classes and sites in this case, the one inch class proved satisfactory, but where the range of diameters involved is smaller, more accurate diameter measurements would undoubtedly prove necessary.

It is now possible to return to the procedure of estimating. In a previous paragraph it has been shown how to determine the DBH of the median tree. The second step is to determine the DBH of the arithmetic average tree (based on basal area). This may be read directly on the ratio of regression graph or obtained by multiplying by the correction factor 1.13 in the case of redwood. Thus if the median tree equals 8.5 inches the corresponding diameter will be 8.5 x 1.13 = 9.6 inches. Representative trees of about this diameter should next be identified and their heights measured and averaged. The volume of the average tree may now be obtained from a volume table, and the volume

of the plot is the volume of this tree times the number of trees in the plot.

Both the correlation of the median tree to the average tree based on basal area, and the volume of the stand computed from a single tree are not very accurately determined for individual plots; but the errors tend to compensate and become negligible as the number of plots increase. In forty even aged redwood plots of four site classes .1 to .9 acres in size, averaging .3 acres, and from 30 to 70 years of age the median found for individual plots by the regression curve differed from the average tree based on basal area by from —8 to +12%, while for the forty plots together the average difference was but 1.5%.

In individual plots the difference between the volume determined by the method just described, and the volume as computed on the basis of a complete diameter tally was from —10 to +15%; while for the forty plots the total difference was 3% with a standard deviation of 5%.

This established the utility of this method for redwood. In order to test its application to other species, two additional computations were made.

The coefficient of correlation of the median tree and the average tree based on basal area in 20 plots of pure even aged western yellow pine, sites I and II, averaging in size .25 acres was as high as .96 $\pm$ .013 with a ratio of regression of .99, giving a curve starting from the exact origin. The correction factor to be used in this case (comparable to the 1.13 for redwood) would therefore be .99. The difference in volume for the plots computed by the two methods was 1%.

The coefficient of correlation in 20 plots of even aged stands of mixed Douglas fir, western yellow pine, sugar pine, and incense cedar, the plots averaging .2 acres in size on sites I, II, and III was .925 $\pm$ .022 with a ratio of regression of .78. The difference in volume was 3%.

A precaution in using this method is necessary. Only plots with a typical distribution of the trees among the DBH classes should be used both in computing the coefficient of correlation and the ratio of regression, and in estimating by the use of the ratio of regression. For example: in redwood the distribution of the trees among the various diameter classes is usually normal; i. e., the greatest number are concentrated near the average and median diameters, the very

large and very small trees being scarce. Occasionally, however, a stand will be encountered which is abnormal, and in which, for example, very small trees are more numerous than those of average size. Such stands should not be used nor estimated by this method. Two of the forty redwood plots examined were of this character, (Fig. 2). An estimate of these by the above described method gave results 43% and 50% in error. In western yellow pine on the other hand, the typical distribution is characterized by a greater number of trees of small diameter.[5] No plots with an abnormal distribution were encountered, but if they exist they should not be estimated by this method. It is believed that such abnormal plots can readily be identified by inspection in the field.

The fact that this fairly accurate and much simplified method is satisfactory in estimating redwood, a tolerant species; and western yellow pine an intolerant species, and mixed stands of Douglas fir, western yellow pine, sugar pine, and incense cedar suggests that it may be generally applicable to all coniferous species.

---

[5]This difference in distribution of diameters explains the big difference between the ratios of regression in the above species.

REVIEWS

The Western Yellow Pine Mistletoe, By Clarence F. Korstian, Forest Service, and W. H. Long, Bureau of Plant Industry. Pp. 1-35.

On account of the wide spread damage to the western yellow pine the authors have presented very detailed data on the life history and characteristics of the mistletoe (*Razoumofskya cryptopoda* (Engelm.) Cov.) as a result of studies extending over a period of 12 years.

Considering that the most dangerous attack is often on the most exposed dry sites and that heavy cutting is necessary to eradicate the disease, the problem is indeed a serious one. The mistletoe, moreover, develops rapidly after cutting and curiously enough it appears "to spread more rapidly and to grow faster on lightly infected trees......" The best remedy is its complete eradication by cutting. Instead of merely cutting mistletoe infected trees on sale areas, the authors make it clear that diseased stands should be sought out and *located* in order to hasten their sanitation. It appears that infection is possible within 300 feet of infected trees. Counting the cost of planting clear cut areas, and yet the need of eliminating all infected trees even if openings must be made, the problem appears to be exceedingly serious and to fully warrant the detailed study that has been made.

T. S. W., Jr.

PAPER PRODUCTION AND CONSUMPTION IN RUSSIA

The question of the paper supply in the U. S. S. R. engaged the attention of the last session of the Timber Commission of the Industrial Section of the State Planning Commission.

According to a report of the Central Paper Trust the consumption of paper is growing continually, and is larger than the output of the paper industry so that paper has to be imported from abroad. Thus, in 1921, the paper output of the Soviet paper industry was 1,700,000 poods, while 1,580,000 poods were imported. In 1922, the consumption of paper was 4,550,000 poods, of which 2,100,000 were manufactured in the country, and the rest imported. The year 1923 shows a considerable increase of production accompanied by a decrease of the imports. Out of a total consumption of 6,535,000 poods, 4,645,000 poods were produced in the Soviet Union, while only 1,888,000 poods were imported.

It is estimated that the consumption of paper in 1924 will amount to 8,500,000 poods, only 70 per cent of which will be contributed by

home production. A similar proportion is anticipated for the following year, when the consumption is expected to reach about 12,000,000 poods. The consumption of paper before the war was about 34 million poods per annum, of which 24 million poods were manufactured in Russia, while 10 million poods were imported from abroad.

The report stated that the paper factories are now working to their utmost capacity, reaching the pre-war output, so that a further increase of the productivity of the factories cannot be expected.

On the other hand due to the growing demand for paper the extension of production is becoming a question of the utmost urgency and importance. At the present moment the paper factories are able to produce 450,000 poods of newsprint paper rolls and 250,000 poods of newsprint sheet paper, whereas the demand for newsprint paper for next year is estimated at 3,500,000 poods of rolls and 800,000 poods of sheet paper. The Central Paper Trust considers it necessary to apply funds to the extension of the mechanical equipment of the existing factories and to the increase of the number of production units.

Insolation, A Factor in the Natural Regeneration of Certain Conifers, By James W. Toumey and Ernest J. Neethling, Yale University Press, School of Forestry, Bulletin No. 11. 60 pages, 10 tables, 18 figures, 2 plates.

After pointing out that the most critical period in the life of a tree is a relatively short time following germination, the authors characterize their investigation as "an attempt to account for the causes of death during this period, more particularly as resulting from insufficient available moisture in the surface soil and from high temperatures at the surface."

They review at some length the earlier work on the same subject. The chief distinction between this investigation and those which have already been reported is that the present observations were made on small seeded areas in the forest. These were selected with reference to the height and density of the surrounding trees and the size of the openings in which these areas were established. The seedlings studied were chiefly white pine, with some hemlock and white spruce included for the purpose of comparisons. Careful descriptions of the areas chosen together with extensive tabular data on the soil moisture and soil temperatures are given and in other tables the extent of the injury in these areas are set forth. For the large amount of data collected and presented in

tabular form, it would seem that the discussions given are rather brief.

Measurements have been made on the rate of downward root elongation of nine species of conifers during the seedling stage.

By exposing seedlings to the sun's rays supplemented by the radiation from electric heaters, the authors were able to produce stem lesions at temperatures found in the soil surface of the forest. Time and intensity were found to be inter-related. The amount of moisture at the surface together with shade were the two important factors which prevented the high surface temperatures which are directly responsible for the lesions.

The finding of these authors, while largely confirmatory to earlier investigations, well accounts for the great loss in conifer seedlings during the first months following germination in the forest habitats.

Manna of larch and of Douglas fir; melezitose and lethal honey. Augustine Henry. Pharm. Jour. and Pharmacist, April 12, 1924.

The writer traces the history of these rare mannas from the time of their earliest mention, in 1542, up to the present. The main theme of the paper is the discussion of the various theories as to the origin of the mannas. Some writers state emphatically that manna is an exudation from the leaves; while others are equally firm in the belief that it is an excretory product of various aphids which suck the juice of the plants bearing the manna. Professor Henry believes that the latter is the correct explanation in almost all cases, but that in rare instances it is formed independently of insect agency, the sugary solution being exuded through stomatic openings of the leaves. Larch manna has been found in the French Alps and in Switzerland. Douglas fir manna was first found in 1914, in British Columbia, and occurs only in hot, dry summers. Other mannas occur on a leguminous shrub in Arabia, Persia, and Asia Minor; on the Cedars of Lebanon; on the western larch in British Columbia; and on two Himalayan pines, *P. excelsa* and *P. longifolia.* Mannas, and also honeydews, consist largely of the rare trisaccharide melezitose, together with sucrose and reducing sugars. Melezitose is sweet, but is toxic to bees. They sometimes procure honeydew when nectar is scarce, and the resultant honey kills them in large numbers. Commercial melezitose is very costly, is obtained from honey, and is used in bacteriological media.

J. J. Willaman.

Larch agaric. Augustine Henry. Pharm. Jour. and Pharmacist, April 26, 1924.

This is a discussion of the history, distribution, and uses of the fungus *Fomes officinalis* (Faull), formerly known as *Polyporus officinalis,* which grows on the stems of larch trees in the Alps and in northern Russia. The fruiting body of the fungus contains from 50 to 70% of resin, which has a strong cathartic action. Agaric acid, a constituent of the resin, has the property of completely inhibiting the action of the sweat glands. The fungus is listed in several European Pharmacopoeias, but not in the British.

J. J. WILLAMAN.

The Properties and Uses of Wood, By Arthur Keehler, McGraw Hill Book Co., 1924. Pages 354, figures and illustrations 129, tables 42.

Developments and results from sound research in wood technology have been numerous in the last decade, and a book incorporating new knowledge in this field is certain of a favorable reception. Since the author of the book in question is, as stated on the title page, Lecturer in Forest Products, the University of Wisconsin and in charge of office of Wood Technology, Forest Products Laboratory, United States Forest Service, he is in close touch with the latest research in the field of wood technology and well prepared to write a book on the properties and uses of wood.

Although the book throughout reflects the association of the author with the Forest Products Laboratory and does include much that has not appeared heretofore in book form, a certain disappointment results, after reading, that some chapters and articles were not treated in greater detail, particularly when so many pertinent data are available. For example, the chapters dealing with wood preservation are treated in a rather superficial manner; paper making gets one short article, and the subject of gluing is only mentioned in two places. However, in fairness to the author, it should be noted that he states in his preface that the presentation is "in as non-technical a manner as is consistent with clearness and accuracy," and that to get together the vast amount of information accumulated by the U. S. Forest Products Laboratory, and to "condense the more important matter and leave out much of the detail, though interesting and valuable, was no small task." . . . .
"Most of the book is devoted mainly to the discussion of the properties of wood. The discussion about the utilization of wood comprises only

that minimum which shows that the uses to which wood in general or any particular species of wood are put depend ultimately on the properties of wood." Both purpose of author and necessity have therefore caused the omission of much which would be desirable, and required for detailed study.

There are 14 chapters of 343 pages, the first six chapters of 165 pages being given over entirely to the structure of wood and its mechanical, physical and chemical properties. These subjects are for the most part handled in an excellent, concise and easily understood manner. Chapter I, "The Structure of Wood," is a clear cut presentation of the various elements composing wood, their relation to tree morphology and physiology. Chapters II and III are given over to the physical properties of wood. While the subject matter includes those phases commonly found in discussions in this field, much more material than is ordinarily contained on the moisture content of wood, its relation to drying, swelling and shrinkage, is found than has usually appeared before. This is a direct result of the attention given in the last decade to the kiln drying of wood.

Chapter IV, "The Mechanical Properties or Strength of Wood" is well done from the standpoint of subject matter, diagrams and tabular material. In this chapter are two rather long tables from U. S. Department of Agriculture Bulletin 556, ("Mechanical Properties of Woods Grown in the United States") one being the results of tests on the strength of small clear green pieces of wood and the other the results of tests on small clear air-dry pieces of wood. The value of incorporating much of the material found in section 43, to wit, the "Forest Service Recommendations for the Grading of Structural Timber," is questionable. Undoubtedly the reader is only too glad to have this thoroughly worth while information. Nevertheless before its adoption and use, such material is likely to be changed and if so, that part of the book becomes at once more or less obsolete. That, however, is something to concern the publisher. Such information is always worth while to those interested in strength of timber and its relation to developments in grading.

Chapter V contains a discussion of the "Factors Affecting the Strength of Wooden Members." The relationships of density, locality of growth, the portion of the tree from which the wood is cut, live and dead timber, to the strength of wood illustrate some of the points which are clearly presented.

Chapter VI, "The Chemical Properties of Wood," is entirely too brief, from the standpoint of both subject matter and references. In outline it is excellent in that it mentions the chemical composition of wood, combustibility, gas production, paper making, wood distillation, leaching, extracts, ethyl alcohol, stock food, ash content and other substances derived from the chemical conversion of wood. In most of the articles the treatment is brief and insufficiently specific, and all too few references are available to whoever wishes to pursue further studies in these matters. If mathematical formulae dealing with the mechanical properties are given in Chapter IV, it would not be inconsistent to give some of the more common equations of the chemical reactions that take place in paper making.

Chapter VII gives a good summary of our present knowledge of the air seasoning of wood. Kiln drying, treated in the next chapter is somewhat of a disappointment in view of the large amount of excellent material available at Madison. To be sure the moisture content of lumber and its relation to drying is covered in Chapters II and III, and it may be that the author did not care to repeat much of the material that has appeared from the pen of other members of the Forest Service at the Forest Products Laboratory. Nevertheless, it is felt that more detailed treatment of types of kilns, operation, and drying schedules would have been well worth while.

The Deterioration of Wood, covered in Chapter IX, deals briefly with decay, insects, marine borers, fire and other factors which tend to destroy wood. The treatment is similar to that as covered in other works on this subject; once again the criticism must be made that the references are insufficient. With a wealth of material on many of these subjects, a few more might well have been included.

"Protection of Wood Against Decay and Fire" is the title of Chapter X. The part in particular dealing with decay, preservatives, and standard methods of treating is given too little and too superficial mention. Some of the material which emanates from the American Wood Preservers' Association, constantly being brought up to date, could well have furnished some excellent subject matter here. Specifications of preservatives and service tests are not mentioned.

Chapter XI could well be omitted and the space given to some of the subjects previously discussed. The title "Principal Factors Governing the Use of Wood," in article 106, covers a long list of the obvious factors which favor and limit the uses of wood; in articles 107-109, "Timber Resources of the United States," "Lumber Prices," and "Sub-

stitute Materials" are treated. All of the material is interesting but the inclusion of such in a book devoted to the large field of Wood Technology is of doubtful value.

Chapter XII, "Kinds and Quantity of Wood Used for Various Purposes," however, presents material which is of direct relation to the text. The products are classified into groups according to the way in which they are prepared for use, "Rough and Hewed Products," "Primary Milled Products" and "Manufactured Products," each group being treated in some detail. Table XXXI shows for the principal industries using wood the annual consumption by species. Although the date for these statistics is not given, the value of the table is considerable since it shows at a glance the comparative amounts of wood entering into our various manufactured wooden products.

A brief treatment of the measurement of timber products occurs in Chapter XIII. The board foot, cubic foot, cord, linear foot, individual piece, and surface measure are defined.

Chapter XIV, the last, deals with "Commercial Grading and Standard Sizes of Lumber." A list of the principal associations which have grading rules, definitions of common defects, summarized rules for the grading of white pine and for hardwoods, and five tables dealing with "Standard Sizes" take up most of this chapter. The last article, 120, deals with the "Standard Grading Specifications proposed by the Government," (U. S. Dept. of Agriculture Circulars 295 and 296.) This material is desirable to have but as stated in reviewing Chapter IV, the specifications are far from being in an accepted state, and their incorporation in a book is open to the objections there expressed. What is given in this chapter is well presented, but here again the subject is too broad to be satisfactorily covered within a short chapter of a book.

For the layman or reader who desires a somewhat comprehensive knowledge of the mechanical and physical properties of wood, and a general idea of wood preservation, wood seasoning and grading, "The Properties and Uses of Wood" will be exactly what he wants, but for college use the book can scarcely serve as a text in itself. It will be useful, extremely so, as an outline for study which must be supplemented by much in the way of specific references to the subjects under consideration. It is impossible to incorporate in a book of this size, all of the subjects presented, and do justice to each. Excellent diagrams and illustrations are furnished throughout.

C. H. GUISE,
October 21, 1924.

"Elements of Forestry," By F. Moon and N. C. Brown, 2nd Ed. 1924, John Wiley & Sons, N. Y., pp. XVII—409.

Other books have been written on the Elements of Forestry, but none that treats the subject so broadly as that of Moon and Brown, who are respectively, Dean of the New York State College of Forestry at Syracuse University and a professor at the same institution. The authors have avoided the use of all scientific names and generalized the statements as much as possible. Hence the book proves to be valuable to those who have no previous knowledge of forestry.

The first edition was written in 1914. Since that time, numerous changes have taken place in the forest practice of this country and the authors have deemed it necessary to revise this old edition and bring it more up-to-date by adding two new chapters on the State and National Forest practices which have advanced so rapidly during this last decade. Numerous statistics are gathered from reliable sources and new information is given as to the recent problems of American Forestry.

The book proper consists of a total of three hundred and eighty-seven pages and is divided into twenty-four chapters. The first chapter sets forth a clear definition of the word Forestry as distinguished from lumbering and arboriculture. The history and development of forestry in America are vividly described and compared with conditions abroad especially with Germany. Great emphasis is given on the need of forestry in this country.

The subject of Silviculture begins with the study of parts, functions and characteristics of the tree, followed by a study of silvics. Different methods and systems of silvicultural management are mentioned. The comparative advantages and disadvantages between natural and artificial regeneration are noted. The subject closes with the description of the methods of planting and nursery practice.

Chapter VII is devoted to forest protection against both natural and human agencies. Although, as the authors say, much has been done in the way of preventing forest fire by the different means of control, greater cooperation should be asked from the people, who need to be educated along such lines.

The study of wood utilization is preceded by a sketch of the history and methods of the lumber industry. The manifold uses of forest products are enumerated and particular attention is called to the Forest Products Laboratory in Madison, Wisconsin. The properties and structure of the wood are dwelt upon as being important to the problem of wood preservation.

The different phases of forest management are not so fully treated as might be expected, only one paragraph being given to working plans. The financial phases of forest management are discussed in the two chapters called "Forest Economics" and "Forest Finance," in which the authors impress the reader with the idea that forestry is a good investment to be made for the benefit of the younger generation.

The latter part of the book contains a study of the seven forest regions in America as to their respective location, forest characteristics, silvicultural treatment, protection and utilization. This part of the book serves best to acquaint the reader with the conditions existing in the United States.

The salient feature of the book is the explicit presentation of such a wide subject. It is well illustrated with pictures that are both impressive and educational and is supplemented by well chosen tables. As a whole, the book is very popularly written and deserves to repeat the success of the first edition.

Ithaca, N. Y. A. B. RECKNAGEL.
October 28, 1924

Manual of Tree and Shrub Insects, By Ephraim Porter Felt, MacMillan Company, 1924. Pp. 382. Fig. 256.

There has long been a need for a compact and usable handbook of tree and shrub insects and Dr. Felt's latest work is a welcome contribution to the literature of this subject. In this book he has brought together much information concerning the more important insect pests of woody plants. The volume is profusely illustrated with excellent figures which add much to its attractiveness and usefulness. It is unfortunate that some errors have slipped in, such as that on page 229 where the figure of Chrysobothris has been substituted for that of the pales weevil, but such accidents are almost unavoidable.

The book is divided into four parts. In the first part is included a brief general discussion of insect anatomy, transformations, origin and a very general and rather inadequate summary of literature. In this part there is also a general discussion of natural checks and control methods as applied primarily to shade and ornamental tree insects. Part two deals with insects that attack shade trees and ornamentals, part three with forest insects and part four with a systematic account of tree frequenting insects in general. The attempt to separate the forest and shade tree insects is not entirely successful inasmuch as there can be no

sharp line setting off such arbitrary divisions. It will be somewhat surprising to the forester in using this manual to find such important forest pests as the gipsy moth, the cottonwood leaf beetle, the forest tent caterpillar, the catalpa sphinx, the poplar borer, and the locust borer treated only as shade tree insects. As a manual of shade tree insects the book should be a decided success, but its value to the forester is somewhat questionable.

Presumably the book is intended for use in the West as well as in the East, but aside from the Dendroctonus beetles there are so few of the western species considered that its value west of the plains region is dubious.

At first glance, judging from the large number of references, one would assume that the literature of tree insects had been completely covered, but on closer inspection we find that many of the most important references to original sources have been omitted. In a manual such as this a complete bibliography is out of the question but an author may be expected to cite one or two of the most important publications dealing with each insect. Repeatedly the only reference made is to Felt's "Insects Affecting Park and Woodland Trees," Mem. 8, New York State Museum, which is itself a compilation, when there are important original works on the subject under discussion. For instance, no reference is made to the following outstanding publications:

Dusham—Painted Hickory Borer—Cornell U. Ag. Exp. Sta. Bul. 407.

Kotinsky—Sugar Maple Borer—Farmer's Bul. 1169.

Hess—Ribbed Pine Borer—Cornell U. Ag. Exp. Sta. Mem. 33.

Matheson—Poplar and Willow Borer—Cornell U. Ag. Exp. Sta. Bul. 338.

Chapman—Two Lined Chestnut Borer—Jl. Agric. Res. 111 No. 4, pp. 283-294.

In each of the above cases only Mem. 8 was cited.

But in spite of the shortcomings mentioned in this review this manual helps to fill a very real need. With the exception of Houser's very excellent publication, Bulletin 332, Ohio Agric. Exp. Sta. entitled "Destructive Insects Affecting Ohio Shade and Forest Trees," now out of print, Dr. Felt's Manual is the only compact work on tree insects that we have in this country and it should be well received by all interested in this subject.

L. A. G.

CURRENT LITERATURE

Compiled by Helen E. Stockbridge, Librarian, U. S. Forest Service.

LIST FOR NOVEMBER, 1924

(Books and periodical articles indexed in library of U. S. Forest Service.)

Forestry as a Whole

Proceedings and reports of associations, forest officers, etc.

India—United Provinces—Forest dept. Annual report of forest administration for the period 1st April, 1922, to 31st March, 1923. 140 p. Allahabad, 1923.

Norway—Skogdirektren. Innberetning om det Norske skogvesen for kalenderaret 1923. 93 p. Kristiania, 1924.

Philippine Islands—Bureau of forestry. Annual report of the director of forestry for the fiscal year ended Dec. 31, 1923. 163 p. pl. Manila, 1924.

Forest Aesthetics

New York state college of forestry, Syracuse university. Historical trees of the state of New York. 20 p. illus. Syracuse, 1923.

Pack, C. L. The forest poetic, new edition. 32 p. Wash., D. C., American tree association, 1924.

Forest Education

Arbor day

North Carolina—Supt. of public instruction. Arbor day program, Nov. 21, 1924. 15 p. Raleigh, N. C., 1924.

Forest schools

New York state college of forestry, Syracuse university. Announcement of courses, 1923-1924. 42 p. Syracuse, 1924. (Circular no. 42.)

Forest Description

Canada—Dept. of the interior—Natural resources intelligence service. Map of southern portion of Dominion of Canada indicating vegetation and forest cover. Ottawa, 1924.

Forest Botany

Kessell, S. L. and Gardner, C. A. Key to the eucalypts of Western Australia. 128 p. illus. Perth, 1924. (Western Australia—Forests dept. Bulletin 34.)

Maiden, J. H. The forest flora of New South Wales, pt. 77. 19 p. pl. Sydney, 1924.

Philippine Islands—Bureau of forestry. A dictionary of names applied to trees of the first, second and third groups. 40 p. Manila, 1923. (Bulletin no. 23.)

Silviculture

Planting and nursery practice

U. S.—Dept. of agriculture—Bureau of plant industry—Office of dry-land agriculture. Cooperative shelter-belt demonstrations on the northern great plains. 4 p. Wash., D. C., 1924. (Publication no. 1, revised.)

Forest Protection

Insects

New York state college of forestry, Syracuse university. Papers from the department of forest entomology. 336 p. illus. Syracuse, 1924. (Technical publication no. 17.)

Diseases

Darrow, G. M. and Detwiler, S. B. Currants and gooseberries: their culture and relation to white-pine blister rust. 38 p. illus. Wash., D. C., 1924. (U. S.—Dept. of agriculture. Farmers' bulletin 1398.)

Fire

France—Ministère de l'agriculture—Direction générale des eaux et forêts. Défense des forêts contre l'incendie. 110 p. Paris, Berger-Levrault, 1923.

Forest Policy

University of Minnesota. Forestry a public question. 15 p. Minneapolis, 1924.

Forest Administration

Annuaire des eaux et forêts, contenant le tableau complet au 30 Octobre 1923, du personnel de l'administration des eaux et forêts. vol. 61. 337 p. Paris, Berger-Levrault, 1924.

Forest Utilization

National conference on utilization of forest products. Wood waste prevention: a digest of the problem before the conference. 29 p. illus. Wash., D. C., 1924.

Lumber industry

Southern logging association. Proceedings of the 14th annual meeting, 1924. 95 p. New Orleans, La., 1924.

U. S.—Dept. of commerce—Bureau of standards. Simplified practice recommendation no 16: lumber. 62 p. diagrs. Wash., D. C., 1924.

Wood-using industries

Joint vocational education committee. Facilities for correspondence and class instruction on the manufacture of pulp and paper available in the United States and Canada. 7 p. N. Y., 1924.

McKee, E. R. The French turpentining system applied to longleaf pine. 16 p. illus. Wash., D. C., 1924. (U. S.—Dept. of agriculture, Dept. circular 327.)

Wise, L. E. Chemical treasures of the forest. 28 p. illus. Wash., D. C., American forestry association, 1924.

Forest by-products

West, A. P. and Smith, F. L., 2d. Commercial products from lumbang oil. 39 p. pl. Manila, 1923. (P. I.—Bureau of forestry, bulletin no. 24.)

Wood Technology

Clarke, S. A. Kiln drying of Western Australian hardwoods, with notes on the testing of seasoned timber. 8 p. Perth, 1922. Western Australia—Forests dept. bulletin 28.)

Jones, W. S. Timbers: their structure and identification. 148 p. illus. Oxford, Eng., Clarendon press. 1924.

Record, S. J. and Mell, C. D. Timbers of tropical America. 610 p. pl. New Haven, Conn., Yale university press, 1924.

Auxiliary Subjects

Public lands

U. S.—General land office. Public land system of the United States. 18 p Wash., D. C., 1924.

National parks

Canada—Dept. of the interior—Canadian national parks branch. Report for the year ending Mar. 31, 1923. 36 p. illus. Ottawa, 1924.

Mycology

Melin, E. Experimentelle untersuchungen über die konstitution und ökologie der mykorrhizen von Pinus silvestris L. und Picea abies (L.) Karst. 259 p. illus. pl. Cassel, Gebr. Gotthelft, 1923.

Periodical Articles

Miscellaneous periodicals

Breeders' gazette, Nov. 20, 1924.—Young steers on Montana ranges, by W. C. Barnes, p. 488-9.

Chemical and metallurgical engineering, Nov. 3, 1924.—Some notes on copal gum, by W. M. Myers, p. 702.

Country gentleman. Sept. 27, 1924.—Beauty by the roadside: some helpful points on highway landscaping, by J. Jensen, p. 13, 39.

Engineering and contracting: roads and streets, Nov. 5, 1924.—National forests road systems, by L. I. Hewes, p. 1021-4; Roads for fighting forest fires, by W. A. Gillette, p. 1039-40.

Gardeners' chronicle, Nov. 1, 1924.—Evergreen hedges by T. Coomber, p. 305.

Gardeners' chronicle, Nov. 15, 1924.—A new pinetum, by W. J. Bean, p. 337.

Military engineer, Nov.-Dec. 1924.—The preservation of marine structures, by W. G. Atwood, p. 507-10.

National wool grower, Nov. 1924.—Light burning on British Columbia forest lands, by T. Mackenzie, p. 23-4.

Nature magazine, Sept. 1924.—The enemy of the forest, p. 159-61; The lightest wood in the world, by R. N. Davis, p. 166-7, 170; The red maple, a popular tree, by L. W. Brownell, p. 173-5.

Outdoor America, Nov. 1924.—A warning to California, by Z. Grey, p. 5-7; Are Kaibab deer doomed, by S. T. Mather, p. 14-17, 59; Mesa Verde, by L. W. Spencer, p. 32-4.

Queensland agricultural journal, Sept. 1924.—Queensland trees: Lucuma amorphosperma, by C. T. White and W. D. Francis, p. 238-9.

Queensland agricultural journal, Oct. 1924.—A universal index to wood, by E. H. F. Swain, p. 278-81; Possibilities of camphor cultivation in Queensland by C. T. White, p. 308; Queensland trees: Endiandra compresso, by C. T. White and W. D. Francis, p. 308-10.

Science, Nov. 14, 1924.—Thermal expansion of wood, by O. P. Hendershot, p. 456-7.

South African journal of industries, Oct. 1924.—Experimental timber preservation in South Africa, by H. B. Stephens, p. 651-6.

Sunset magazine, Dec. 1924.—"Every odd section": the Northern Pacific demands its pound of flesh close to the heart of the national forests, by T. Knappen, p. 11-13, 54, 56; Ranger Shinn: the story of a man who shaped his life to get the greatest happiness, by W. C. Barnes, p. 32, 60, 62; How nails can help preserve western timber, p. 46.

U. S.—Dept. of agriculture. Journal of agricultural research, May 31, 1924.—Density of cell sap in relation to environmental conditions in the Wasatch mountains of Utah, by C. F. Korstian, p. 845-907.

U. S.—Dept. of agriculture. Official bulletin, Nov. 19, 1924.—Cooperate to build forest roads, p. 6.

Trade journals and commerce reports

American lumberman, Nov. 8, 1924.—Timber saving by painting and preservation, by F. L. Browne, p. 59.

American lumberman, Nov. 15, 1924.—New plank road across desert sands, by R. M. Morton, p. 64.

American lumberman, Nov. 22, 1924.—Utilization conference unites all interests in program for wood conservation, p. 44-55; Waste problems, by W. B. Greeley, p. 45-7.

Canada lumberman, Nov. 1, 1924.—Canadian silviculture and its possibilities, by E. H. Finlayson, p. 38, 44.

Canada lumberman, Nov. 15, 1924.—Communications in forest protection, by J. H. Thompson, p. 49-50.

Four L bulletin, Nov. 1924.—Forest students and forest schools need cooperation and assistance of lumber industry, by G. W. Peavy, p. 11, 35; The father of congresses: George M. Cornwall, by J. D. Guthrie, p. 13.

Hardwood record, Nov. 10, 1924.—A contrast in kiln results, by J. P. Klinker, p. 22-4.

Hardwood record, Nov. 25, 1924.—An interesting phase of drying, by A. J. Cross, p. 26-9.

Lumber and veneer consumer, Oct. 30, 1924.—Imminent extinction of a tree species: expert foresters pronounce doom of eastern and southeastern chestnut, p. 13-15; Oak, our age-long friend, by S. M. Nickey, p. 20-1; A hardwood that made good: red gum, p. 22-4; Forest fire prevention in France, p. 25.

Lumber manufacturer and dealer, Nov. 14, 1924.—How wood-using industries are asked to save half the drain on forests, p. 25-30.

Lumber trade journal, Nov. 1, 1924.—Forest fire prevention on privately owned lands, by H. E. Hardtner, p. 33-4; Logging to conform with state conservation contracts, by P. S. Bunker, p. 36-7; Southern pine beetle and other insect enemies of southern forests, by R. A. St. George, p. 37-8.

Lumber trade journal, Nov. 15, 1924.—Comparative table southern pine production, p. 11.

Lumber world review, Nov. 10, 1924.—Teutonic forestry, by B. A. Johnson and others, p. 51-69; Putting market research information to work, by O. T. Swan, p. 70-4; Some thoughts on "Continental" and "English" forestry, by S. O. Johnson, p. 74-5; Reforestation in Georgia, by C. B. Harman, p. 76-9; Saving the trees by using all our native species, by B. H. Paul, p. 79-80; How forest investigations are of use to loggers, by E. T. Allen, p. 82-5; Unified control needed in the lumber industry, by L. A. Lamb, p. 89-91; Empire state forest products association annual, by A. B. Recknagel, p. 91-2; Use more stickers and save lumber, by L. V. Teesdale, p. 92-3; Reforestation: what is the answer in lake states, by J. Kittredge, Jr., p. 94-5; Decay in Douglas fir in relation to cruising, by J. S. Boyce, p. 100-1; Objectives of the new federal forest experiment station, by T. T. Munger, p. 101-2; The tenth Appalachian logging congress, p. 112-21; The fourteenth annual Southern logging congress, p. 121-36.

Lumber world review, Nov. 25, 1924.—The problem of wood waste prevention, p. 28-32; A summarization of the need for forest conservation, by Calvin Coolidge, p. 42; Avoiding waste by manufacture of dimension stock, by E. Hines, p. 45-7; Utilization of little used species of wood, by H. Oldenburg, p. 47; Close utilization as a factor in permanence of forest industry, by A. C. Goodyear, p. 47-8; Logging and milling losses in Pacific coast states, by R. W. Vinnedge, p. 48-51; Possible reductions in lumber seasoning losses, by C. S. Keith, p. 51-2; Small sawmill waste and a remedy for it, by J. H. Allen, p. 52; Design of saws to reduce waste, and practical limitations, by H. C. Atkins, p. 52-4.

National coopers' journal, Nov. 1924.—Investigation and experiment to eliminate mold and stain on container stock, by E. E. Hubert, p. 11.

Naval stores review, Nov. 1, 1924.—The forest of the Landes, by P. J. Lacoste, p. 16-17, 23; New growth of pine forests in Georgia, by J. C. Nash, p. 28-9; Account of the trip of the American naval stores commission in Spain, by W. L'E. Barnett, p. 30-1.

Naval stores review, Nov. 22, 1924.—Sowing and planting pines in the south, by W. R. Mattoon, p. 16-17, 21.

Naval stores review, Nov. 29, 1924.—What are the probable returns from growing trees in the south, p. 10.

Paper, Nov. 6, 1924.—College course in papermaking, by H. E. Weston, p. 101-2.

Paper, Nov. 13, 1924.—Interesting straw pulping invention, by V. Drewsen, p. 141-2.

Paper industry, Oct. 1924.—Aerial photography in forestry, logging and engineering, by E. Wilson, p. 1207-13.

Paper trade journal, Oct. 16, 1924.—Economic factors in the pulping of wood wastes, by J. D. Rue, p. 45-6; Bentonite for pitch trouble, by S. D. Wells, p. 47-8.

Paper trade journal, Oct. 30, 1924.—Rapid development in paper industry on coast, by G. D. Bearce, p. 23-6; Pulp and paper mills of North America and Europe, p. 64, 66.

Pulp and paper magazine, Nov. 6, 1924.—Who fights our forest fires, p. 1145.

Pulp and paper magazine, Nov. 13, 1924.—Some researches on pulpwood, by R. Sieber, p. 1165-8.

Southern lumber journal, Nov. 15, 1924.—Use of cut-over pine lands in northern Florida, by W. W. Ashe, p. 30-2.

Southern lumberman, Nov. 8, 1924.—Standards for manufacturing lumber, by W. A. Anderson, p. 39.

Southern lumberman, Nov. 15, 1924.—What's the matter with the naval stores industry, by J. F. Carter, p. 39-40.

Southern lumberman, Nov. 22, 1924.—Waste problems in southern hardwoods, by M. W. Stark, p. 37.

Southern lumberman. Nov. 29, 1924.—The railways and wood preservation, by R. H. Aishton, p. 45-6.

Timber trades journal, Nov. 1, 1924.—Peruvian timber, p. 1345.

Timber trades journal, Nov. 8, 1924.—British Columbia timber for the United Kingdom, by L. L. Brown, p. 1406-10.

Timberman, Nov. 1924.—Year's review of logging development, by G. M. Cornwall, p. 49; the fifteenth Pacific logging congress, p. 50-112; Salvaging pulp wood from "slash," or re-logging, by W. A. Erwin, p. 63-4; The Forest products laboratory, by W. H. Gibbons, p. 64-5; White pine blister rust in the Pacific northwest, by S. N. Wyckoff, p. 108; Clancy log rafting system, p. 116; Redwood for reforestation in the Douglas fir region, by D. T. Mason, p. 130-2; Portable pumps for fighting forest fires, by S. Buck, p. 142; West coast grading rules are completed, p. 237-8.

U. S. commerce report, Nov. 10, 1924.—Lumber exports and imports during September, by A. E. Boadle, p. 342.

U. S. commerce report, Nov. 17, 1924.—Kinds and uses of Philippine woods, p. 412-13.

U. S. commerce report, Nov. 24, 1924.—Finland's forest resources, by L. A. Davis, p. 459.

West coast lumberman, Nov. 1, 1924.—Fire conscious, by G. C. Joy, p. 66-9.

West coast lumberman, Nov. 15, 1924.—Survey of the Australian lumber market, by E. G. Pauly, p. 32; Forest fire losses decrease while number of fires increase, p. 44.

Wood turning, Nov. 1924.—Second progress report on factory hardwood grading, by the Forest products laboratory, p. 14-26.

Forest journals

Allgemeine forst—und jagdzeitung, Oct. 1924.—Zur systematik der betriebsformen, by Vanselow, p. 429-34; Waldbauliche erhebungen in missigen beständen des Schwarzwalds (oberen buntsandstein), by V. Dieterich, p. 434-48; Fällungs—und räumungsschäden, by Stephani, p. 448-54; Die holzindustrie Schwedens, by F. Heske, p. 454-61; Geschichtliche entwicklung der staatsforstverwaltung in Preussen, by A. Schwappach, p. 461-72.

Australian forestry journal, Sept. 1924.—Forest entomology: timber boring beetles, by W. W. Froggatt, p. 228-30; Forests and rainfall, p. 231-2; Forestry and farming, by H. R. Gray, p. 236-46.

Forest leaves, Dec. 1924.—A comparative study of natural and artificial regeneration in Potter county, by W. S. Swingler, p. 179-80; The forest in every day life, by G. H. Wirt, p. 181; What is the forest protection problem in Pennsylvania, by G. H. Wirt, p. 182-4; Should we plant white pine, by J. W. Keller, p. 184-5; Why Pennsylvania needs more state forests, by R. Y. Stuart, p. 187-8.

Forstwissenschaftliches centralblatt, Oct. 15, 1924.—Die maschine im forstbetrieb, by K. Beringer, p. 565-96.

Hawaiian forester and agriculturist, July-Sept. 1924.—Forestry for water conservation, by C. S. Judd, p. 98-102.

Illustrated Canadian forest and outdoors, Nov. 1924.—Canada's forest heritage, by C. D. Howe, p. 649-50; The travelling school in tree planting, p. 659; Control of timber cutting, by E. H. Finlayson, p. 665-7; Forest areas and pulpwood resources in Canada, p. 668; Why China has famine. p. 675; Tote road sketches: a comparison of the Pacific coast logger of yesterday and today, by E. W. Towler, p. 679-81; Forestry along the railway, p. 682.

Indian forester, Nov. 1924.—Hot air, or timber seasoning in various countries, by S. Fitzgerald, p. 564-7; Some notes and problems of the Central Provinces teak areas, p. 567-72; Chiengmai lacquer ware, p. 597-603.

Journal forestier suisse, Nov. 1924.—La taxation cadastrale des forêts, by H. Biolley, p. 213 18; Apparition du bombyce disparate dans un taillis de châtaignier au Tessin, by H. Badoux, p. 223-7.

Quarterly journal of forestry, Oct. 1924.—A note on a recent forest tour in Germany, by R. Bourne, p. 319-32; Some edaphic factors in forest ecology, by P. S. Spokes, p. 333-46.

Revue des eaux et forêts, Oct. 1924.—Un mission forestière en Syrie, by P. Monnet, p. 445-51; Culture industrielle du pin maritime, by R. Pallu and others, p. 452-61; Une méthode de plantation économique, by Montariol, p. 462-5.

Schweizerische zeitschrift für forstwesen, Nov. 1924.—Forstliche reiseskizzen aus Lappland, by G. Winkelmann, p. 341-9; Ablösung von waldweidrechten (wun und weid) im Kanton Schaffhausen, by A. Gujer, p. 349-55; Die forstlichen verhältnisse der Tschecho-slovakie, by A. Nechleba, p. 355-65.

Société forestière de Franche-Comté. Bulletin trimestriel, Sept. 1924.—Les droits d'usage forestiers du Comté de Dabo, by G. Huffel, p. 326-41; Les forêts dans le Gard, by A. Flaugère, p. 372-82.

Zeitschrift für forst—und jagdwesen, July 1924.—Die Harter'schen pflugdammkulturen im sächs. staatsforstrevier Dresden, by Wiedemann and Gärtner, p. 387-99; Weitere entwicklung der harznutzung an der gemeinen kiefer Pinus silvestris L., by M. Kienitz, p. 399-429; Ist die trennung von haupt—und vornutzung noch zeitgemäss, by Gehrhardt, p. 429-40.

NOTES

AN IMPROVED SAWMILL APPLIANCE

Notable among improved sawmill appliances are the new Martin Air Dogs for log carriages. All the human doggers are dispensed with and only the setter rides the carriage. Each set of dogs is operated from a separate air cylinder placed on top or the sides of the knees. There may thus be two cylinders on each knee, and since the taper device is also operated by air there may be a third cylinder. The setter now operates not only the set works but also the dogs. A busy man before the advent of the air dogs, he now performs what seems to be a superhuman task with incredible ease and speed. The handling of logs on carriages equipped with the air dogs seems now more magical than ever.

The saving of labor is the most apparent gain, though this is somewhat offset by higher wages paid the setter and, in some cases, the sawyer. But there is another gain that should appeal to those interested in the conservation of standing timber through better utilization in the mill. Heretofore it was next to impossible to cause setters and sawyers to use the taper levers and take advantage of the gain possible from sawing parallel to the bark. With the Martin dogs, however, there is also supplied an air operated taper device which is so easily and quickly operated by the setter that there no longer exists an excuse for sawing triangular shaped slabs from tapered logs and suffering the consequent loss in value of the product. This feature alone makes the Martin automatic air operated equipment noteworthy. Not content with operating the dogs and taper automatically, a jet of air is played on the headblocks in front of the knees and clears them of chips or bark that may prevent the log or cant coming up against the knees.

E. F.

A heavy dripping fog rolled in from the Pacific ocean and put out effectively a fierce forest fire which had been burning for days in the Olympic peninsula southwest of Port Angeles, Wash. This is the only time recorded in northwest forestry of the occurrence of such a phenomenon. With no indication of rain and lacking water with which to fight the advance of the flaming menace, foresters watched the fire making progress toward the town of Quilcene, beyond which lay valuable tracts of big trees, when suddenly the wet fog descended. Like a huge gray cloud it settled down upon the forest enshrouding

everything. The fire fighters fled in terror lest they become bewildered and lost on the mountain side. Soon the pungent smell of cedar and hemlock smoke disappeared and by mid-afternoon when the fog lifted there remained but a few smoking dead logs, while all about the charred trunks of former merchantable trees dripped with water from the providential fire extinguisher.

SCIENCE SERVICE

Eleven varieties of chestnuts, secured from the Yunnan Province of southwestern China, are now under cultivation by the Bureau of Plant Industry of the Department of Agriculture. It is hoped to secure from these at least one type that will resist the blight which has ruined so much of the native chestnut crop. The trees as yet are only in the seedling stage. Among them is one which, in Yunnan, produces nuts nearly twice the size of the common American variety. This tree is described as suitable for orchard culture. It grows wild at an altitude of about 8,000 feet.

New York may acquire a community forest, or plant one, by recommendation of Professor Hugh Findlay, of Columbia University, who is directing work along the lines of reforestation and tree conservation for university extension students. Central Park and the New York Botanical Gardens will be used by his students as laboratories in experimental work. A special investigation will be made of the importance of birds to forest and home trees, and of the use of trees in industry. (Science, Vol. LX, No. 1558, p. 428, Nov. 7, 1924.)

FOREST PLANTING WITH A PLOW

As the time for planting approaches, ways and means become a problem with a great many of us. The method herewith described, is one seldom employed, that is worthy of more general use.

Plows have frequently been employed to open a furrow, in the bottom of which trees were planted with a mattock. In this case the plow is the only tool used and is employed to make the hole in which the trees are planted.

The method is simple, single furrows being plowed for each row of trees. The planter carries the trees in a pail or basket and estimates or paces the distance between trees. Holding the stem of the tree in one hand, he spreads the roots in the bottom of the furrow and holds the tree against the land side of the furrow. With the other hand, or foot, or both, the mould is pulled back into the furrow, for

a distance of about a foot each side of the tree. How much the dirt is to be pressed down over the roots, depends upon the condition and nature of the soil. Usually after placing an inch or more soil over the roots, it is well to press firmly with the foot, leaving the remaining earth used to fill the furrow, rather loose.

It is obvious that this method requires land that can be plowed and is particularly adapted to abandoned farms. Good results can be obtained on pretty rough land, for the furrow need not be very deep or straight. A reversible or hill side plow is best for hilly situations.

ADVANTAGES

On sloping ground rain collects in the open sections of furrow and is carried down to the trees. For this reason furrows should be plowed at an angle with the slope, to get this result. If on the other hand the site is very wet, it may be advantageous to have the furrows at right angles to the slope, the water will then tend to drain into the open sections, giving the tree roots a little air.

Ofttimes it saves buying and sharpening tools that cannot be used for other work.

Any farmer can understand this method and do the work with equipment at hand and without supervision.

Labor of the poorest sort can be used since little headwork or special effort is required to do a good job.

Under average conditions it is cheaper than planting with mattocks.

For large stock or extensive root systems it is ideal.

CONCLUSION

In rough and stony ground the writer estimates that three men and a team will plant about one-third more trees, than four men with mattocks, or between two and three thousand trees.

In Northern New Jersey this method gave results on abandoned fields, equal or better than the best mattock work.

PAUL B. HAINES.

PONDOSA PINE

Foresters will smile when they see this name appear on the letterheads and advertisements of lumber companies of the Inland Empire, for it is obviously a new name for *Pinus ponderosa*. No commercial wood of America has so many pseudonyms and aliases, and one name more will not add much to the harm that has already been caused by past

misnaming. "Pondosa Pine" is now the official trade name of the Western Pine Manufacturers Association for *Pinus ponderosa* and replaces the very misleading name of "Western White Pine" held as official since about 1918. Previous to this, the official association trade name was "Western Pine." The Forest Service insists on calling it Western Yellow Pine, for yellow pine it is and western also. This name is, of course, unfortunate because we have many western yellow pines. It is a pity that the early settlers did not invent a distinctive name comparable to Jeffrey Pine, Digger Pine, Sugar Pine, and others. Every trade name so far used—Baker White Pine, Oregon White Pine, Western White Pine, California White Pine, Arizona White Pine, and others—attempts to conceal the wood's yellow pine relationship and plagiarize on the reputation of its famous rival, the white pine of the Northeast and Lake States, *Pinus strobus*. No tree or wood is less deserving of being so treated as a step-child, for it is a noble tree in every part of its range and its wood possesses exceptionally high technical qualities. And while it "fills the bill" as well as white pine for many uses, it is not a white pine any more than Muskrat fur is Hudson Bay Seal; and the consignee discovers this the moment he goes through his first car of this wood. To call it white pine with one of the many prefixes indicating a locality is clearly a deception and unworthy of ethical trade practice. It brands our excellent *Pinus ponderosa* as a substitute wood. It is too good a wood not to deserve a reputation of its own based on its merits.

It is gratifying indeed that the association godfathers have not added the word "white" to the new designation. "Pondosa Pine" as a name, while unnecessary, has this advantage—it is distinctive and not deceptive, and as such is to be commended.

E. F.

UNIVERSITY OF CALIFORNIA ADDS A NEW ASSISTANT PROFESSOR OF FORESTRY TO ITS STAFF

The Division of Forestry of the University of California in 1922 established a chair in range management for the purpose of broadening the training of the technical forester by offering courses in range management. At the same time an active program of range researches was undertaken. The demand for grazing work has become so great that it became necessary to add another member to the forestry staff. The new position was filled in October by Mr. H. E. Malmsten, with the title of Assistant Professor of Forestry.

Mr. Malmsten received the B. S. Degree in Forestry from the University of Idaho in 1917. He comes to the University as Associate Range Examiner of the Forest Service. While in the Forest Service he was actively engaged in range investigative work which has consisted of grazing reconnaissance, the fundamentals with respect to the time the ranges may be grazed with impunity, and much other detailed experimental work at the Great Basin Experiment Station. His technical training and many years of valuable experience in the Forest Service have well prepared him for the new duties which he has assumed.
Berkeley, Nov. 20, 1924.

SOUTHERN FORESTRY CONGRESS

The 7th annual meeting of the Southern Forestry Congress will be held in Little Rock, Arkansas, January 19-21. The first two days will be devoted to a program covering several problems of particular interest to the South at this time; including the better management of the pine and hard-wood forests, the paper and pulp industry in the South, the establishment of a National Park in the southern Appalachians, etc. The third day will be devoted to a trip to the Hot Springs National Park, where park administration can be studied at first hand.

Lumbermen and others interested in the commercial utilization of timber and other forest products have always been some of the most active members of the Congress, and it has been the special aim of the Executive Committee to keep all discussions on a practical basis. It is hoped that the coming meeting will be no exception to the rule, and that the business side of forestry will be emphasized.

President.

THE UTILIZATION CONFERENCE

By Aldo Leopold

The National Conference on Utilization of Forest Products which met as Washington, November 19 and 20, at the call of the Secretary of Agriculture, was attended by nearly 400 representatives of the timber and wood using industries.

A subject of lively discussion was the question of *What is Preventable Waste?*

There were two attitudes toward this question, which, shown of the confusion and overlapping which always attends the attempt to define a new issue, may be briefly described as follows:

1. "If there really were preventable wastes, a competitive industry would automatically and immediately eliminate them. Therefore this prevention is not economically feasible."

2. "Elimination of these 'preventable' wastes depends on a more perfect organization of each industry, a condition which does not yet exist, but which may gradually be accomplished. Until this is done the individual cannot do much."

That the second attitude is somewhat nearer the truth is indicated by the fact that the proponents of the first join heartily in devising a permanent committee to accomplish better industrial organization.

It is probably true that the bulk of the possible savings in woods and mill waste, use of inferior species and grades, and the removal of needless economic obstacles actually depend on trade association effort, and are not now generally attainable by independent individual effort. That is to say, the second attitude is correct with respect to these items.

But the bulk of the possible savings in decay prevention, better seasoning, and more economical pulp processes are probably attainable by individual effort, requiring merely a higher (but potentially profitable) investment in skilled personnel and finely adjusted equipment. That is to say, neither the first nor the second attitude seems correct with respect to these items.

In woods and mill wastes, the one most promising means of prevention is the manufacture of dimension stock. This depends on standardization of kinds and sizes and standardization is in the nature of things a collective, rather than an individual enterprise.

The most promising means for obtaining utilization of inferior species is education of dealers and consumers. This education is likewise in the nature of things a collective enterprise. Another promising means is in better grouping of industries, which requires mainly the education of the bankers who finance wood-using plants. I do not know who can best do this.

The removal of economic obstacles means, for example, obtaining freight rates which will move low-grade material to places where it can be used, instead of leaving it as waste at its point of origin. Obviously the individual can do little toward such adjustments, and it is doubtful if the trade associations can do much. The initiative must come from the makers of rates, and the incentive must be the increased volume of profitable traffic.

Hence the conclusion that woods and mill wastes, inferior species, and economic adjustments are, by and large, a more promising field for trade association than for individual activity.

In decay prevention, however, we have a different situation. There is nothing to prevent the individual mine or railroad from preserving a higher proportion of its ties and timbers, nor the individual farmer or farm bureau or local telephone company from owning an open-tank outfit for preserving posts and poles. There is nothing to prevent the individual retailer from keeping a sanitary yard free from dangerous infections, and advertising that fact to his customers.

Likewise with better seasoning practice. There is nothing to prevent the individual sawmill operator from treating lumber for bluestain or using the latest improvements in kiln drying. If he can finance the additional equipment and is willing to risk the use of finely adjusted as distinguished from rule-of-thumb processes, he can profit by using the best method.

Trade association initiative is helpful but not necessary to the successful use of these betterments. Hence the conclusion that only inertia and lack of knowledge of improved practice prevents their widespread adoption.

Another point that provoked discussion was the assertion that industry rather than Government must take the responsibility for getting better utilization into practice—there was difference of opinion. One type of industrialist says flatly that the Government must do it. One wonders whether he would not say something emphatic about "less Government in business" if the Government should make the error of following his advice. The majority, however, seemed to regard the fourth premise as sound, questioning only the ability of the industries to organize effectively and to finance the work adequately. There is ample justification for such a question. Our industrial civilization has not yet evolved efficient devices for combining the liaison function between industry and Government with the trade-association function and the function of internal self-betterment. The existing situation presents an opportunity to evolve such devices. To meet this opportunity successfully might not only solve the utilization problem but contribute something of vital importance to our whole political and economic system.

IMPORTANT CONSERVATION MEETINGS HELD IN CALIFORNIA

That there is an awakened interest in Western States for better handling of forest, oil, water, and agricultural resources was made quite

evident at two meetings at each of which conservation of natural resources occupied a large part of the programs.

On November 19, 1924, the California Development Association unveiled a mammoth relief map of the state which is permanently installed in the Ferry Building, San Francisco. The Development Association is really the state chamber of commerce, and delegates from every county in the state were present for the ceremony. Taking advantage of the opportunity in having present so many business men from all sections of California, Mr. Norman H. Sloane, formerly a forest supervisor, now the very capable general manager of the California Development Association, carried through a very successful afternoon's program on conservation. Wood, water, recreation, oil, minerals, and grazing lands were discussed. There was strong evidence of a rapidly-developing public sentiment which may in the near future insist on permanent forest management throughout California's forests.

The second meeting was held in Los Angeles, December 2nd and 3rd, 1924, and was a Pacific-Coast-wide meeting rather than a state meeting. It marked an important forward step in forestry on the Pacific slope. The western division of the Chamber of Commerce of the United States was in session, with several hundred delegates present from the eleven western states, Hawaii and the Philippines. The two-day session was devoted to detail discussions of four topics: Extravagance in industry and in government; the business of farming; reforestation and shipping. The forestry portion of the program included fourteen addresses from business men, lumbermen, and foresters, emphasizing sharply the importance of doing something big and definite at once. It is hoped that action may result, perhaps through the United States Chamber of Commerce as a whole.

The long fight is bringing results. It is quite certain that the western states, on the threshold of a great future, are going ahead with something of a definite plan and are not going to make the same mistakes of their Eastern sister states.

University of California,
Division of Forestry,
Dec. 8, 1924.

FORESTERS' MEETING IN WEST VIRGINIA

At Elkins, West Virginia, on December 4, 1924, those named on the following page met to consider the problems and progress of

forestry in that State. The discussion of the statements presented regarding various activities in forestry by the interests represented extended the conference throughout the day and evening, and resulted in the decision that those practicing forestry in West Virginia who are eligible for membership in the Society of American Foresters should affiliate with the Allegheny Section. Among those attending the conference were:

A. B. Brooks, Chief Game Warden of West Virginia.

P. M. Browning, Chief Forest Fire Warden of West Virginia.

John Foley, Forester, Pennsylvania Railroad System.

W. L. Gooch, Forester, Elk River Coal & Lumber Co.

W. E. Hedges, Supervisor, Monongahela National Forest.

F. C. Henneberger, Forest Examiner Monongahela National Forest.

S. G. Hobart, Forester, Gauley Coal Land Company.

J. W. Karr, State Forest Fire Ranger, Pocahontas District.

Kenneth McDonald, Consulting Timber Engineer.

F. H. Mayers, Assistant Forester, Cherry River Boom and Lumber Co.

O. O. Nutter, State Forest Fire Ranger, Northern District.

B. L. Roberts, Forester, Cherry River Boom and Lumber Co.

Thomas W. Skuce, Extension Forester, University of W. Va.

E. N. Wriston, State Forest Fire Ranger, Kanawha District.

The action reported above provided for the promotion of professional forest practice in West Virginia, but was not regarded as meeting the demand for popular education in the State's need for conservation of its fast-disappearing forest resources. Therefore the West Virginia Forestry Association was launched again, with Messrs. Gooch, Roberts, and Browning, as President, Vice President, and Secretary-Treasurer, respectively.

JOHN FOLEY,
Chairman, Allegheny Section.

NATIONAL RESEARCH FELLOWSHIPS IN THE BIOLOGICAL SCIENCES

(Zoology, Botany, Anthropology and Psychology)

These fellowships are supported by the Rockefeller Foundation and are administered by a Board appointed by the National Research Council.

The fellowships are open to citizens of both sexes of the United States and Canada who possess a Ph.D. degree or its equivalent. They are intended primarliy for relatively recent graduates and not

for those already professionally established. The purpose of the National Research Fellowships in the Biological Sciences is the promotion of fundamental research in these subjects through the development of an increasing number of thoroughly trained investigators.

The basic stipends awarded per annum are $1,800 for unmarried fellows and $2,300 for married fellows. These stipends may be increased when there are other dependents or for other cogent reasons. Awards are made for one year, but fellowships may be renewed. Fellows are chosen at semi-annual meetings of the Board in April and September; applications must be filed before March 1st and August 1st respectively in order to insure consideration at the following meeting.

The fellowships are not granted to any institution or university, but the choice of place to work is left to the fellow, subject to the approval of the Fellowship Board. The appointments are for full time and no other remunerative or routine work is permitted.

For further information concerning these fellowships address: Chairman, Board of National Research Fellowships in the Biological Sciences, National Research Council, Washington, D. C.

CONTENTS